AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

VOLUME 20. NEW YORK, THURSDAY, JULY 22, 1897. NUMBER 29.

American and Other Machinery Abroad—XI.

(Editorial Correspondence.)

GERMAN MACHINERY TRADE.

Germany is at present experiencing what may be called almost a boom in the machinery trade, and it is, for the present at least, the most important foreign market for our American machine tools; besides which a great many American steam pumps and other classes of machinery which we have especially developed find a large sale here.

I find in Germany three distinct classes or kinds of machine shops. One of these consists of the old-style shops which have been entirely untouched by modern ideas; shops in which they use flat drills exclusively, do a very large proportion of their work by hand and pursue the methods of thirty to fifty years ago, uncontaminated by a single modern idea. A second class consists of those shops which have been in operation for a long time and have old tools and old methods in use alongside of new tools and modern methods; the evident intention being to gradually bring them up to present-day practice. The most important class to us is the third, which, though not yet very numerous, will probably increase in numbers and importance, and will, by its influence, hasten the modernization or the retirement of the others. This is composed of the most modern shops, with the best possible equipment, practically all of which is American in design, and much of it of American manufacture. In such shops there is evidence not only of abundance of capital, but also of a thorough acquaintance with what is going on elsewhere, and it is especially noticeable that our most advanced ideas are liberally made use of and in some cases improved upon.

In fact, the pains that are evidently taken to keep informed regarding the rest of the world and to make use of that information, is a prominent feature of the industrial situation here, and though there is a good deal of mere slavish copying (some of it with discreditable accompaniments), there is also a good deal of original work by good concerns, who, as a foundation for that original work, simply study and base their practice upon our best models—something which we can take no reasonable exception to, I think, especially as we have ourselves done, and still do, a good deal of the same adaptive work, and must do so from the very nature of things.

GERMAN EFFORTS TO KEEP INFORMED.

In Chemnitz, where a considerable portion of our American cotton goes, and is returned to us in the form of hosiery and knit underwear, I found an establishment, building textile machinery mainly, in modern shops of excellent construction, and found them taking and reading sixty foreign technical and trade journals, besides the German ones; one man devoting his time to the translation from these foreign journals of such articles as seemed likely to be of service to the engineers of the establishment. This inclination to make full use of the available means of advancement in technical knowledge is quite general among the advancing class. I asked a German tool-builder if he could suggest any means of still further increasing the circulation and influence of the "American Machinist" here, and he said that if an edition of it were to be published in German, probably three or four thousand additional subscribers would be obtained; but in his opinion its influence as a means of introducing American machinery would not be materially increased, for practically all those concerns which are open to new ideas and that are likely to be purchasers of American machinery, already take and carefully read it. This opinion was confirmed by another shop owner, and I speak of it here only as being, perhaps, the best illustration I can give of the extent to which they go in their determination to keep themselves thoroughly informed in regard to what is going on in America in machinery lines. They do not wait for ideas and new things to be forced upon them, but reach out after them.

SHOP PRACTICE.

The original, and what is now the older shop practice of Germany has evidently been based upon English practice, while the new and modern practice here is essentially American.

An almost indelible mark seems to have been made by the English in the matter of lathe practice here, the German lathesman following English methods in this, except in the few instances where he has been especially educated to do otherwise. As in Britain, the German workman thinks a lathe is no lathe at all unless it has a compound rest; and quite often he will have the gibs of the carriage so tight that it is difficult to move it upon the bed, and all the value of the carriage movement as a manipulative operation is destroyed. He seems to think this is necessary in order that the carriage shall not be accidentally moved, and then he depends upon the upper slide of the compound rest for his fine movements of the tool parallel with the line of centers. The far superior value of the rise-and-fall rest on the small lathe seems to be almost entirely unknown or ignored, and in discussing the matter with some Americans living here they inform me that this is a point in which it seems well night impossible to bring about any change; for the readiness to accept new ideas and to do things in new ways, to which I have referred, does not by any means extend to the German workman. He reads little or nothing pertaining to his occupation, and for the most part doggedly follows the practice of his predecessors, learning new things slowly or not at all.

One German shop proprietor who put in some lathes for turning certain work not requiring to be threaded had great difficulty in getting men to run them because they had no lead-screws. They refused to recognize a lead-screwless machine as a lathe, and the lathes actually stood still for some weeks, perhaps months, for lack of men to run them, and were finally taken hold of by untrained men who were not conscious of the disgrace they were bringing upon themselves. This is not trade unionism, but conservatism and stupidity. In one shop the superintendent of which is an American, they put in a large American boring and turning mill, the first machine of its kind ever seen by the men employed there. Under similar circumstances in an American machine shop, it is safe to say that there would be scarcely a man in the

shop who would not be secretly hoping if not openly asking for a chance to start up the new machine and see what could be made of it. Not so here, however, for something like twenty men were tried before one was found who would and at the same time could operate the machine, though among those tried were most of the best workmen in the shop. They seemed instinctively to dislike the machine because it was different from the lathes to which they had been accustomed; and were afraid of its heavy feeds and inclination to take heavy cuts. Finally, about the time it was thought a man had been found who would stick to the machine he quit, frankly saying that he was afraid of it; but after a few weeks he returned, said he had been thinking the matter over and would like to try again. At the time of my visit he was running the machine and doing very well with it.

An American lathe was sold to one of the prominent establishments, and upon being set up the spindle moved stiffly, owing to the thickening of the oil, which had hardened somewhat in the bearings. The workman loosed the bearings, then put kerosene into them; which cleaned out the thick oil and left the boxes very loose. Then the centers had to be turned to an angle of about 90 degrees (instead of our standard 60 degrees), and in getting the live center out of the spindle the workman found no thread and nut upon it for forcing it out. He had been used to the threaded center and the nut for removing it; roundly abused the far distant American builders who had failed to provide them, and proceeded to remove the center by vigorous use of a hammer upon its projecting portion, entirely failing to understand that, unlike British and German lathes, this American tool had a hollow spindle, and that a small rod of round steel passed through it constituted the obvious and easy means of center removal. The centers having been turned to the more blunt angle, they were hardened and put into the lathe, and then the lathe generally condemned as inaccurate and worthless. A mechanic representing the dealer found them ready for him with elaborate contraptions designed to demontrate the inaccuracy of the lathe; but he only tightened the boxes properly, ground the centers in place, showed them how to remove the centers when necessary and came away, leaving them satisfied of the accuracy of the tool, and with the consciousness that things are not always what they seem. These incidents show simply that there is yet much work to be done; but it is going forward rapidly, and a noticeable feature of the modern German workshops is their neatness and cleanliness and the neatness and cleanliness of the men who work in them. New factory buildings are often highly ornamented and present a very attractive appearance, and few, if any, shops in America have more or better washing and bathing facilities. These are made use of, too, and you can by no means always tell the difference between a draftsman and a machinist when they come from the shop at night. The contrast between Germany and England is quite a strong one in this respect.

SOME MACHINERY DEALERS IN BERLIN.

A vivid idea of the magnitude of the American machinery trade here is obtained by a call at the establishment of Schuchardt & Schutte, whose principal business has grown to be in American machinery tools since 1893, previous to which time they dealt only in steel, machinists' supplies, etc. They have branch establishments in Vienna and in Brussels, but here in Berlin seventy-six people are employed in handling the business. There are at present ten traveling men, and will soon be thirteen, and several of our American manufacturers find this house their largest customer. One tool-building establishment in Cincinnati has for some time past disposed of 40 per cent. of its product through this single channel, and, by contemplated enlargements of premises and employment of additional men, the business will soon be materially increased. At present they are fitting up a sample room where, in suitable showcases, will be kept a sample of every small tool handled by them; so that here, in a tastefully arranged room, are to be seen perhaps a larger variety of American small tools than can be found anywhere else within a single room. In this room it is the intention to have buyers who come to Berlin make their selections, instead of going about from place to place in the store, where tools must be removed from packages or shelves and are often overlooked entirely and never shown to the best advantage.

Few, if any, better commercial organizations are to be found anywhere than this one seems to be, and as an instance of how things are managed, Mr. Schutte told me that, in the morning when the mail arrives, two, besides himself, go through it, and, the first thing afterward, send out telegrams to the various travelers directing them to answer in person such inquiries as had been received that seemed to be of such a character as to promise business. Thus all such inquiries bring a representative to the spot usually the next day, and the lead can be closely followed up, and business developed from it if possible.

The space occupied by the business here in Berlin is large, including five ordinary store fronts, on the ground floor, with room extending back from them and with the offices—business, clerical, etc., on the second floor.

At the principal German port of entry, Hamburg, they have arrangements by which much American machinery simply stops there in its original packing and is, when sold, shipped direct to the customer without coming through Berlin at all.

The advantage of being on the ground is shown by the growth of their business in Austria, where, since the establishment of their Vienna branch, the business in that country has grown to five times its former proportions; and they expect good results in Belgium from their Brussels branch, which is, as yet, only about two months old.

Gustav Diechmann & Son prefer apparently to handle the product of only a few builders whose accredited agents they are here, and this fact, of course, limits the total volume of their business somewhat, notwithstanding their large sales within these few lines. At the time of my call upon them, they remarked that their stock was unusually depleted, because, a few days before, some Russians had suddenly stepped into the store and in a very few minutes had purchased the bulk of it, to be shipped to Russia at once.

Besides these there is De Fries & Co., who are just opening business and will be the special representatives of Davis & Egan, besides handling other tools. This firm has its headquarters in Dusseldorf, where it is engaged in manufacturing operations, and where it is fitting up a large and very magnificent show-room for the exhibition of machine tools, and will have an electric traveling crane for handling them, and electric motors for driving tools when it is desired to exhibit them at work. Dusseldorf is in the midst of an important manufacturing district where a good deal of American machinery has already been sold.

I find here in Berlin also Mr. Francis C. Pratt, of Hartford, who, of course, devotes his time and talents to the interests of the Pratt & Whitney Company, and has, to assist him in this, the prestige which comes from the fact that Pratt & Whitney were the pioneers of the trade here and did very important work in fitting up armories in Germany during the early '70s; Mr. Pratt's father being on that account very well and very favorably known among the Government engineers and those army officers who have to do with arms manufacture.

BUSINESS PROSPECTS.

German tool-builders are simply overrun with orders, and Mr. Loewe, of Ldw. Loewe & Co., to whom I am especially indebted for valuable assistance in the prosecution of my studies here, told me they had for some time past been able to accept only about one-fourth of the orders for machine tools offered them. He is of the opinion that this demand for tools will continue for some time at least, for there are very many establishments that must either be newly equipped or go out of business, and thus throw their business into the hands of those already better equipped and able to enlarge, and that this in itself will mean large sales of machine tools.

His firm is building a new works in

which to build machine tools, of which works we shall probably be able to give some account later. I am convinced, from a study of the drawings and a tour of the now partially erected buildings, that it will be one of the most magnificent manufacturing establishments of the world; neither capital nor study by the best minds having been spared to make it as nearly perfect and as well appointed as the present state of the art of workshop construction will permit. This building and its equipment will cost in the neighborhood of 10,000,000 marks, or about $2,500,000, and though a good deal of its equipment will probably be moved from the present shops, and will be of Ldw. Loewe & Co.'s own manufacture, a great many thousands of dollars' worth has already been ordered in America—in fact, over $100,000 worth of Pratt & Whitney alone.

It is the intention to follow the plan of keeping to a comparatively small variety of machine tools, and making them in large lots and by systematic methods of manufacture.

This undoubtedly means a keen competitor for business here and in neutral markets, for our own methods will be employed, and, in fact, American ideas will largely prevail in the mechanical department of the business, while of the skillful and able management of the business department in the hands of Mr. Loewe and his associates there can be no doubt whatever.

At Chemnitz the establishment of J. E. Reinecker is also particularly well adapted for efficient competition in the machine tool market, and of this establishment there is more to be said in a future issue. As an evidence of its up-to-date-ness I may mention the fact that I found in it three new Bilgram bevel gear planing machines, and, in charge of them Mr. Hoffmann, who until recently was with Bilgram and was in charge of his exhibit at Chicago.

PROTECTION SENTIMENT.

The volume of business done here by American tool builders does not at present worry the German builders at all, because most of them have far more orders than they can fill within a reasonable time; but some of them look forward to a time when business may not be so good here, and when American competition may be felt more keenly. This view of the matter has led to a movement now going on for a concerted action upon the part of German tool builders to ask the government for increased protective duties. They will, it is said, call the attention of the Reichstag to the fact that America imposes a heavy duty on imported machinery, and is now arranging to increase duties generally with the express object of shutting out German and other foreign products. Then they will ask if, in view of these facts, it would not be eminently proper for the German government to protect this German "infant industry" by the imposition of a stiff duty designed to "equalize conditions" and give employment to German capital and labor by, in a measure, shutting out our "cheap" machinery.

I have, however, discussed this matter with several men who have given it some attention, and they assure me that it can scarcely come to anything. They say that leading members of the Reichstag are quite broad-minded in such matters, and will take into consideration the fact that American machinery has done much for Germany's recent industrial development; and the petitioners will very likely be informed that the proper course for them to pursue will be to prepare (as at least one firm I have mentioned is doing) for an effort to produce as good or better machinery at the same or lower cost, and that if they cannot do that then the other interests of Germany and the general welfare of the country demand that the best machinery should be, at all events, secured, and at a not unnaturally enhanced cost. Loewe is himself one of those who do not believe the movement will succeed, or that it ought to do so.

I asked a German-American engineer, who took some such view of the case, how it was that there had nevertheless been a successful movement against the free importation of American meats, and he said the reason was that this movement against the free importation of American food products was backed by the land owners, who form a far more numerous and influential portion of the community than machinery builders ever could form. He said the present land owning class were the descendants of a far less numerous class of landlords, but that they wanted to live as well and do nothing while being supported by the income from a fixed amount of land. The protective movement was simply designed to increase the amount of rents collectable from these lands, by enhancing the price of what could be produced only by the use of them, and was solely in the interest of these landlords who were constitutionally opposed to making any real effort to earn a living, and were influential socially and politically.

HOURS OF LABOR.

A somewhat curious division and arrangement of the working periods of the day prevails here. In business offices men will be found at their desks earlier in the morning than is customary with us, and much later in the evening, but they have an intermission from about 1 to 4 P. M., during which they eat and drink. In a bicycle shop which I visited the men commence work at 6 A. M., stop at 8.30 for coffee; go to work at 9, stop at 12 for dinner; go to work at 1.30, stop at 4 for another meal of some sort, and then work from 4.20 to 7 P. M., thus making the day 13 hours long for just 10 hours' work. This has the advantage of no very long continued period of labor, but makes a long day of it.

TRANSLATIONS OF CATALOGS, ETC.

In France, and here as well, I have made some little investigation of the matter of translations of trade catalogs, pamphlets, etc., into French and German, and find there is much more to the matter than would appear at first sight.

We all know, of course, that in technical literature a literal translation is seldom possible, but there have been, to say nothing of poorly translated matter caused by ignorance, too many attempts to translate as nearly literally as possible, and the results have been, in many cases, simply ridiculous, and there are in Berlin to-day German translations of American catalogs which simply make a German engineer shake with laughter every time he glances through them. They are worse than useless for their intended purpose.

My conclusion is that when a translation of such matter is to be made it may, if we choose, be first made by an educated translator, but afterward, and before going to the printer, should by all means pass through the hands of some one who not only knows German thoroughly, but also understands the technicalities of the subject treated; knows how to transform our American technical terms into their equivalent German ones, and, above all, knows what it is advisable to say and what not to say to German readers.

The really best plan is for a qualified man living here, to first study a given machine, then throw aside the English description of it and write an original one in German, and the same remarks apply with equal force to French translations.

TECHNICAL EDUCATION.

We hear very much in America about German technical education, and what a great thing it has been for their recent industrial development. In England they have been hearing still more of it, and there are those in England who have attributed Germany's success in industrial competition entirely to what they call Germany's thorough and efficient technical schools. One is not here long before he comes into contact with this feature of Germany's industrial organization, and so far at least as mechanical engineering goes, and especially so far as it has to do with the designing of machinery and the management of workshops, one gets the impression that technical education is somewhat overdone—that too much dependence is placed upon it and too little importance is attached to practical shop experience by those who direct industrial operations.

There are a great plenty of men in the shops here who can make very profound

mathematical calculations and can present the most beautiful analyses of mechanical problems; who are filled with the knowledge of Grashoff and of Reuleaux, and because of this are intrusted with responsibility in positions where an American shopman, knowing little or nothing of them, but trained to rely largely upon his own individual and inherited skill and store of experience, would make much the better showing. Of course, I do not mean by this that technical education is detrimental, nor in fact anything more than that here it seems in many cases to be carried too far; men are in school being trained to accept as conclusive the written and oral statements of others, at a time of life when, if ever, the habit of independent thought and action and the spirit of self-reliance must be developed.

Many such men are met with in the shops who know a lot that is to be found in books, but nothing whatever of skilled workshop manipulations, and they seem to have been deprived of the power of acquiring the habit of independent thought.

There are exceptions, of course, and I do not mean to imply, either, that technical education, generally speaking, has been detrimental here; but it is the opinion of those whose experience and observations qualify them to judge of the matter, that there has been too little of the practical element in it, and that it has not, so far as it relates to the art of machine construction, been so beneficial as might be supposed.

WAGES.

We hear much also of the low wages of Germany, and of the menace she becomes on account of them. It is interesting and instructive to observe that as Germany progresses and becomes better and better able to compete in the markets of the world, wages show a decided tendency to rise, and, in fact, they have risen quite appreciably within the past five years.

In one shop I found men operating machines, producing parts of a simple machine which was being systematically manufactured, and earning (piece work) 65 marks per week, or about $14, which here is equivalent to more than that amount in America, where there are plenty of men doing the same class of work who would by no means despise such wages.

The time when Germany's real formidableness as a competitor will fully show itself will be when wages have become practically equal here to what they are elsewhere, and the equalizing process is going on, without doubt.

PROF. REULEAUX.

It is probable that no other one man has done so important a work for the introduction of American machinery here as has been done by Professor Dr. Reuleaux, who lives here in Berlin, and whom I enjoyed the privilege of calling upon. His work has not been done for the purpose of introducing American machinery here, but simply in the interest of what he believed to be the truth, and for the ultimate good of Germany. His report of what he saw and learned of our shop practice and mechanical engineering when he was in America in 1876 was in a sense a criticism of the German practice of the time, and was bitterly resented by many of those interested, who should instead have profoundly thanked him—as, indeed, many of them have since learned enough of the real facts to do.

That report is now clearly seen to have been one of the most important factors, and the real primal impulse, toward a higher plane of industrial development, and American tool-builders are to-day reaping the benefits of it without, in most cases, giving a thought of credit to the man who had the courage to speak the plain truth, and the discernment to see the importance of speaking it, at a time when to do so was very unpopular, and meant, for a time at least, nothing much besides obloquy and abuse.

About a year ago, Professor Reuleaux resigned his position at the Technical High School, and is now devoting his time to authorship, being at the time of my call engaged in reading the proofs of a new work, in which the relation between kinematics and geometry will be investigated and made plain. It is to be hoped that this, like some of his previous books, will be translated into English and placed within the reach of American students of engineering.

I found the Professor still much interested in America and in our doings; fully in touch with us, and regularly reading our most important technical literature. He told me he was for many years the only reader of the "American Machinist" in Germany, whereas now he has abundance of company in this as in other matters concerning America in which for a time he stood alone.

Professor Reuleaux has already accomplished much that is useful not only to his own country, but to other lands as well, and I am sure his many American friends will join in hoping he may be long spared and enabled to complete the engineering literary work he has in hand.

F. J. M.

Berlin, June 29th.

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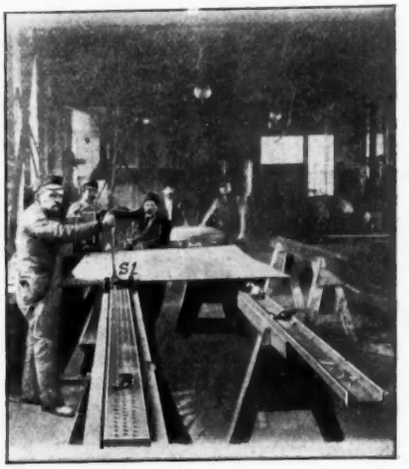
Spacing Rivet Holes.

BY JOHN RANDOL.

For spacing rivet holes in boiler and tank plates, the device commonly seen is in the form of an iron table, more than the length of the longest sheet to be punched and of considerable width, and provided at one edge, commonly that next the punch, with some sort of a spacing device—say, a rack or ratchet-bar the full length of the work table. As this work table is quite heavy, it must of course run on finished ways or guides of some sort, which should be nearly twice the length of the longest sheet to be punched. Then the automatic spacing mechanism has a considerable load to handle, and every pound of weight added to the weight of the sheet to be punched means so much more work for the spacing mechanism; hence the table should be as light as possible. The "automatic" spacing mechanism for machines of this class is commonly operated by hand; so commonly, in fact, that if there are full automatic spacing and punching machines for punching rivet holes in boiler plates, I have never seen them, except for very light and comparatively short work, in which it is not unusual to punch all the holes in one edge of a sheet at once, using a gang of as many punches as there are holes in the long side of the sheet. Of course nothing of this sort would suit a boiler or tank shop making a variety of work, and I think nothing of the kind is used



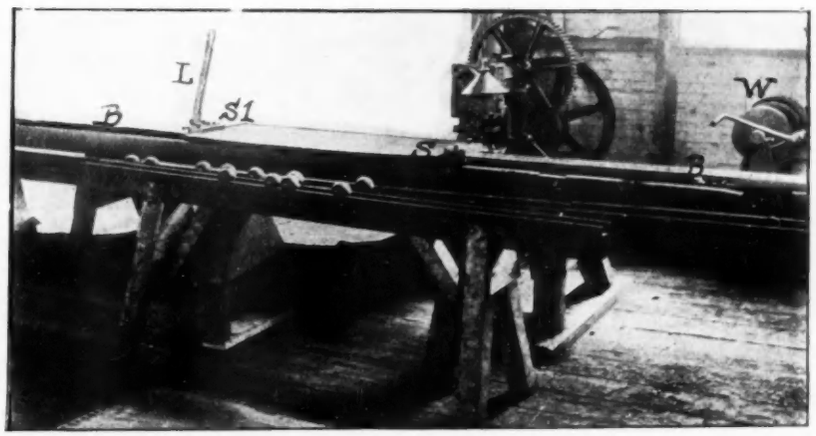
PUNCHING THE PLATES.

outside of manufactories which constantly reproduce the one article.

In boiler shops of the ordinary class the automatic part of the spacing machines consists of devices by which the spacing mechanism is made to move the sheet a certain distance with great exactness, so that the holes punched in two plates will exactly match up when one sheet is laid on the other. It is well known that all rivet-hole work which is laid off by hand with the dividers is found to be unevenly spaced after the holes are punched, and also that when one sheet is punched first and the holes in its mate are marked through the first, some holes invariably fail to come exactly fair, and the drift must be used. All use of the drift pin in sheet-metal work is objectionable, not only because of the loss of time, but especially because drifting is injurious to the sheets, and is often forbidden in specifications for first-class work. It is evident that correct spacing is the first requisite of a good punching machine, and practical devices for the

purpose are not easily found. Punching thick sheets of iron is a rough, hard job, and boiler-makers are not reckoned among the most delicate and careful manipulators of metal, and boiler-shop tools must be very simple and very strong, or they are of no use.

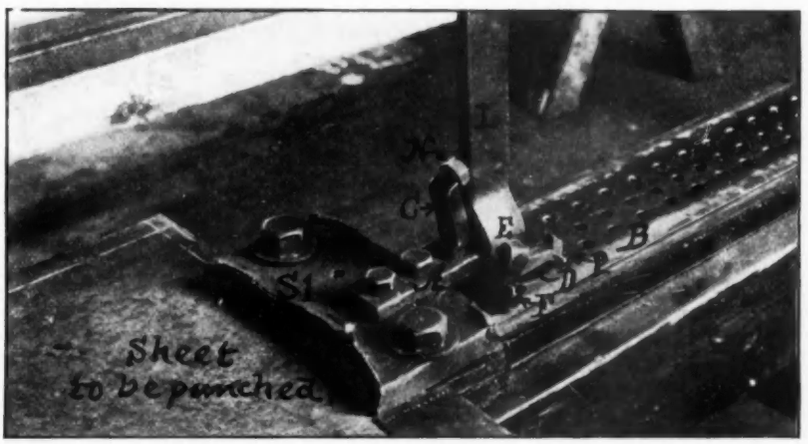
Mr. Aue, superintendent of the De La Vergne shops, was forced to meet this rivet-hole spacing problem, because, as the ice-machine business began to assume considerable proportions, the boiler shops under his charge were called upon for a very large amount of work in the way of tanks, and he solved the problem with the extremely simple and cheap devices shown in the half-tones given herewith, which punch holes so accurately spaced that the use of the drift is unknown in putting this work together.



ROLLER BEARING FOR THE PLATES.

The principal member of Aue's spacing mechanism is the long steel bar, 4 inches wide by ¾ inch thick, planed on the edges only, marked *B* in the engravings. This bar has three rows of holes in it, which may be spaced to any pitch, and the bars may be of any length. Two presses in the De La Vergne shops are fitted with these bars; one of them is 30 feet long, and the other is 40 feet. The first row of holes drilled in one of these bars was laid out by stepping with dividers, and came ¼ inch long in every 10 feet. All of the other rows of holes were laid out by marking from a steel tape stretched on the bar and clamped to it, the location of the holes being marked from the tape, center marked and the holes scribed from the center mark with dividers and pricked on the circumference with fine marks to which the drilling was done, all in the regular machine-shop manner. These long bars cost very little labor, as planing the edges takes only about one hour, while the drilling of each bar occupied about one day. If the space holes had been drilled through a jig having a pin and drill-bush spaced the rivet pitch from center to center, there would have been the same liability to error in total length as in stepping with dividers.

This space bar is mounted on a timber supported on wooden legs, as clearly shown by the pictures, bringing the top of the bar even hight with the top of the die in the press bolster. Two clamp slides *S S*¹ are fitted to move easily on the bar, and these clamps are screwed to the sheet to be punched, one at each end, so that the line of rivet holes will come the right distance from the edge of the sheet. One of these clamps is plain, and is screwed to the leading end of the sheet. The clamp screwed to the following end of the sheet has bolted to its top the bracket *A*, having an upwardly projecting stop-abutment *C*, and an eye at its extreme right-hand rear end through which the bolt *E* passes to make a fulcrum on which the forked hand lever *L* may be vibrated. At the lower end of the hand-lever fork a second bolt *F* forms a fulcrum for the dog *D*. *D* has at its free end a tit on its under side adapted to drop freely into the holes of the space bar; this tit is sloped on the under side at the left hand, so as to automatically lift out of the space-hole when the top of the lever is moved to the right, and has also a small stop-pin *P*, driven cross-wise through it, to ensure the uniform drop of the tit into the space-holes. To obtain the best view possible of these spacing parts, the nut *N* was placed between the stop-abutment *C* and the hand-lever *L*. This nut *N* is no part of the spacing device. Normally the left-hand side of the lever *L* rests against the right-hand side of *C*. There are different holes for the screws which fasten the lever bracket *A* to the top of the clamp so as to bring the dog *D* into any of the lines of holes on the space-bar *B*. The action is as follows: The hand-lever *L* is moved to the right until the tit on the dog *D* drops into a hole in the space-bar. Then the hand-lever is moved to the left until stopped by coming into contact with the abutment *C*. These motions make it certain that the sheet is moved to the left exactly one space as measured by the pitch of the space-bar holes. The sheet cannot be moved if the dog does not engage a space-bar hole, and the abutment *C* confines the lever movement to fixed arc of effective travel.



SPACING DEVICE FOR PUNCHING.

The sheets are lifted to the space-bar by the hand winch *W*, the rope from which passes over overhead pullies and ends with suitable grappling tongs.

Narrow sheets simply slide along on top of the space-bar; for wide sheets, cast-iron balls about 3 inches diameter are placed in channel-iron ways secured to the tops of movable wooden horses, as clearly shown in the engraving; the channel-bar horses being suitably placed to support the overhang of the sheet, thus avoiding the use of a sheet-carrying table.

It would be easy to make a home-made rivet-hole spacing table cost a tidy sum in the way of drawings, patterns and machine work. This job was made without drawings, without patterns, without castings, except the balls which were at hand as a part of a regulating device of some sort, and with only three pieces of forging—the bracket *A*, the lever *L* and the dog *D*—and Mr. Aue thought the whole cost of this spacing-rig for one punch did not exceed $60, including the carpenter work.

We all have due respect for legitimate and conventional methods of shop procedure, we recognize the value of the drawing room, of full records and reliable

cost-books; but a job like this spacing table, made with stock at hand, and perfectly serving the purpose for which it was designed, recalls Thoreau's aphorism, that the true hunter can fire his gun up the chimney and bring the game he wants in at the door. In other words, the right man can do the right thing with small effort and expense.

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Split Chucks.

BY "MACHINIST."

I believe, as far as my information goes, that the watch factory is responsible for the bench lathe and the split chuck. These are not the only good things we can blame the watch factory for. I have known and worked with old watch-factory hands twelve years ago, to whom the Niles smoothing tool for planer work, which you have recently illustrated and described in the "American Machinist," was then an old tool; and I have seen it used by them as long ago as that, and also have used it myself. I have also seen it used upon lathe work. I have found in my own practice, however, in planing, that the tool upon thin work, such as steel gibs, etc., seems to have a pening effect, and, while it leaves a fine surface, the work, when taken from the platen, is slightly bowed. I have never been able to entirely overcome this trouble by any change of form in the tool.

I can remember, and don't have to look back very many years either, when both the bench lathe and the split chuck were regarded by the average machinist not only with levity, but in many cases with levity not unmixed with contempt. The bench lathe is better understood in these days, and its value more thoroughly appreciated. It is now regularly made by standard builders, and no modern toolroom is complete without one bench lathe, and sometimes more. I do not remember to have been in a shop where there were too many of them, and I have been in some in which you had to watch your chance to get in to one at all. How many screws I have seen injured and spoilt while finishing the head in a three-jawed chuck, the jaws of which bore some resemblance to the hippos in Central Park, and perhaps for voracity a more striking one still. A little place, 'way on the back of the jaws, touches the screw shank; and, if you have or can find a piece of sheet brass or copper to wind around the thread, in the mistaken idea that it will protect it from the greedy maw which encircles it, you are ready to begin the job of making the screw run true, preparatory to finishing the head. Now, it may be one of your lucky days,

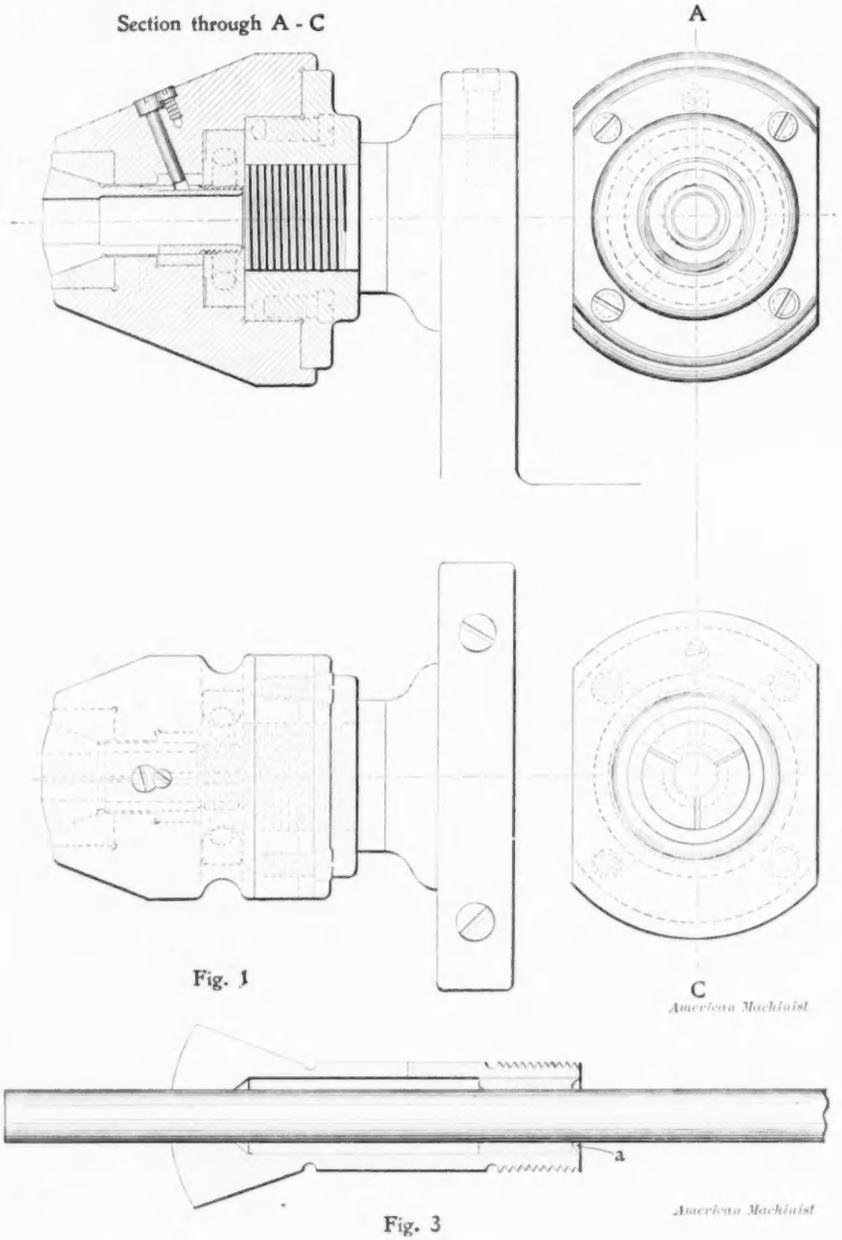


Fig. 1

Fig. 3

SPLIT CHUCKS.

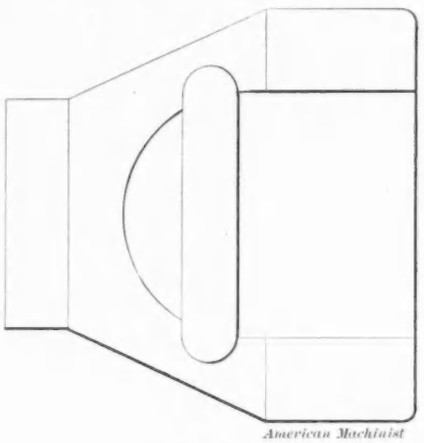


Fig. 4

and by some unaccountable stroke you have got the screw running " 'bout right."

Up comes the shaving tool, both hands wiggling the cross feed and carriage handles in bright anticipation of finishing the job and getting it out of the way. It's nothing but a screw, and does not require any great amount of skill. Well, it's finished sure enough, and out of the way, too, perhaps, if there happens to be an open window handy, and that means anywhere within throwing distance.

I won't dwell on these sad reminiscences longer. Many who may read this will understand just how the tool caught, just how the screw turned hand-springs and flip-flaps and fell in the chip box under the lathe, and how lonesome the shaving tool looked. Something is missed, has gone, flown away never more to return, and the three-jawed chuck gazes on its work with the most utter and stolid indifference.

Many times I have wished for the same conveniences on the ordinary engine or speed lathe that are so keenly appreciated on the bench lathe, with its endless array of split and step chucks, and many other handy rigs. Several tool-builders now make "tool-makers' lathes," with drawing-in spindles, and split chucks, and those workmen are fortunate who can use them.

Not all shops have these lathes, and for

those who have not I will endeavor to describe a holder for split chucks for any lathe, which I designed some years ago. Fig. 1 shows the holder assembled, and Fig. 2 the details. The construction is perhaps more elaborate than some would care for, but I think there is nothing in it that will not add to its life or that in the end will not prove true economy. The holder can be made without the hardened seats for the split chucks, and the chucks themselves can be of cast iron or machine steel and give fair service. I at one time made a very large holder, capable of taking in cast-iron chucks that would hold round stock of 2 inches diameter, that worked well, though of course not lasting as long as one with hardened parts; but the chucks, when worn, were bored to other sizes, there being in most cases sufficient stock for two or three enlargements, the slits in the chuck being filled previous to boring with pieces of the same metal as the chuck that just filled the slits without crowding, the chuck being then drawn down to its seat ready for reboring. It has seemed to me that a split chuck holder of this or some other form would be a profitable article of manufacture, as capable of being attached to any lathe as the ordinary three or four jawed chuck in such common use.

There are so many different fixtures or forms of chucks that can be fitted to the holder for holding such a variety of work which men familiar with the bench lathe know so well about, that the use of the holder is by no means confined to the holding of round stock in split chucks. Even when the lathe has not a hollow spindle it can be used to good advantage, as the center hole in spindle will allow of quite a length of stock extending back into it, many cases not requiring even this.

I find that a bushing in the back end of

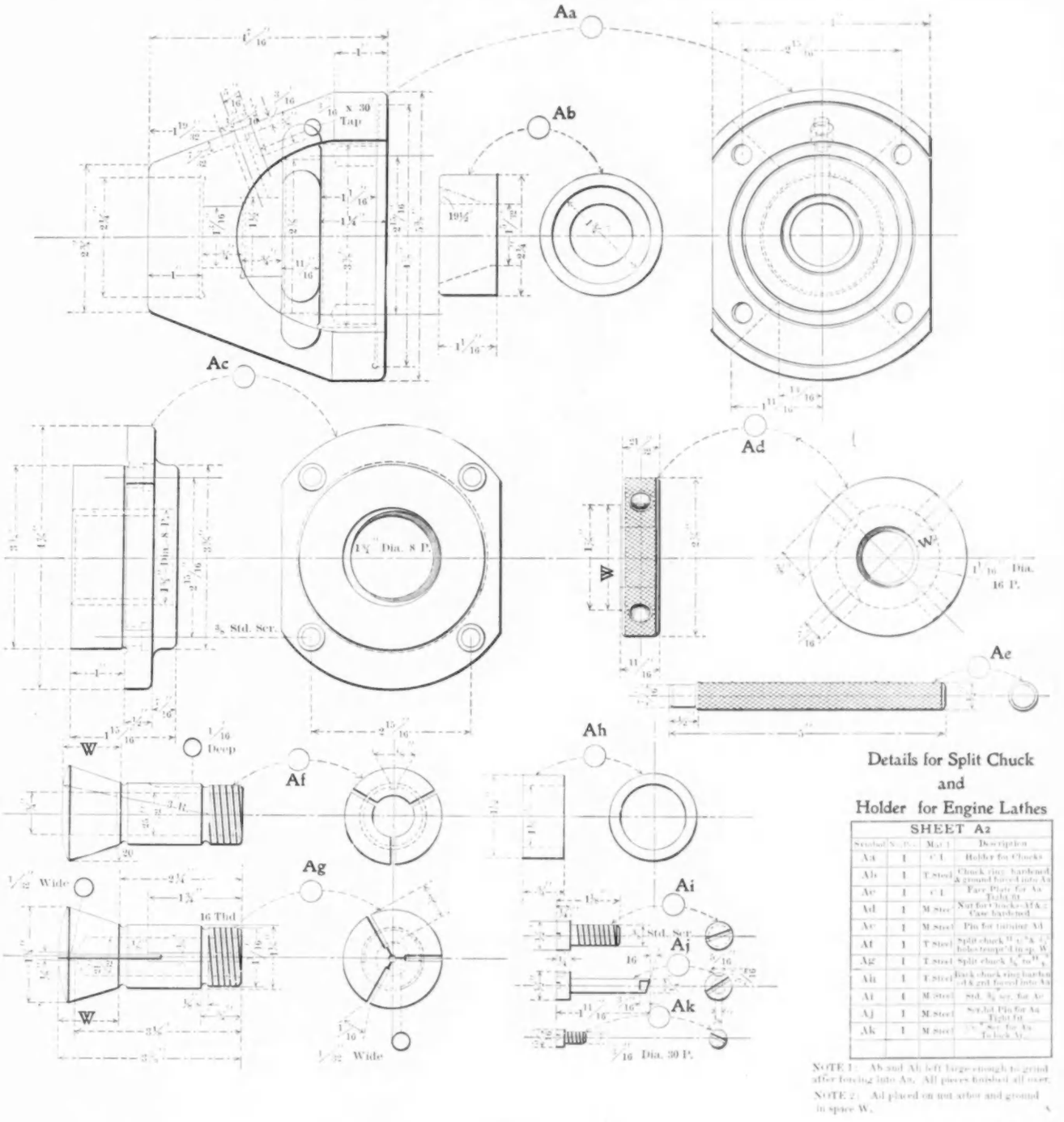

Aa
Ab
Ac
Ad
Ae
Af
Ag
Ah
Ai
Aj
Ak
x 30 Tap
1¾" Dia. 8 P.
⅜ Std. Scr.
W
1 1/16 Dia. 16 P.
1/16 Deep
1/32 Wide
16 Thd
16 Dia. 30 P.
Details for Split Chuck and Holder for Engine Lathes
SHEET A2
Description
Holder for Chucks
Chuck ring, hardened & ground bore A to fit Aa
Face Plate for Aa. Tight fit
Nut for chucks A1 & 2. Case hardened
Pin for turning Ad
Split chuck ½" to 1"
Split chuck ⅝" to 1"
Lock chuck ring hardened & grd bored into Aa
Std. ⅜" scr. for Ac
Split Pin for Aa. Tight fit
⅜" Scr. for Ag to lock Af
NOTE 1: Ab and Ah left large enough to grind after forcing into Aa. All pieces finished all over.
NOTE 2: Ad placed on test arbor and ground in space W.
American Machinist

Fig. 2
SPLIT CHUCKS.

the split chuck, as shown in Fig. 3, about ⅜ inch or ½ inch long, with the hole from .001 to .002 over size of stock and hole in chuck, is a help in keeping work true. If the stock extends far back into the lathe spindle, as it sometimes does, and even out at the back end of it, or if the nature of the work requires it to extend out some distance in front of the chuck, it has a tendency to vibrate while revolving, which prevents accurate work. The bushing in the back end is an aid in preventing this.

I fit the bushing so that it will just push in to the back end of the chuck. I do not like to force it in if the chuck happens to be thin at this end, and if the chuck is also threaded at this point on the outside. I push the bushing in until its outer surface is about 1-16 inch below the back end of the chuck, and with the soldering copper I flow a fillet of solder in the corner thus left as shown at *a*, Fig. 3. I will say here that there is some probability of the bushing being knocked out if a piece of stock happens to stick in the front end of the chuck while putting it in long enough to cause a rush of business when it does condescend to move, but it is easily replaced in a few moments, although if you wait before putting it in until some time in the future when you are in a hurry for that particular chuck and have to hunt for the bushing, you'll think it takes a week. I think this would be an improvement in split chucks that would be worth adopting. Make the bushing of tool steel, harden and lap the hole, place on a mandrel and grind outside to fit back end of chuck, then solder or force it as seems best. Each end of hole in bushing should be rounded out, so the stock will guide through easily. Such a bushing would not only aid in holding the work rigid, but would prevent, to a large extent, the too common fault of trying to force a piece through the chuck .005 or .006 over size. I think quite likely others may have experienced the same trouble that I have, and taken the same means to overcome it. I believe our rule for the length of gripping surface in split chucks used to be one and one-quarter times diameter of stock or hole in chuck.

In making the chuck holder, two face plates *A c* are necessary, one each for the lathe and for the grinding machine. After doing the lathe work, hardening the seats *A b* and *A h*, for the split chucks, and forcing them in, the lathe face plate is removed and the one for the grinding machine takes its place, in order that these hardened parts may be ground true with the turning.

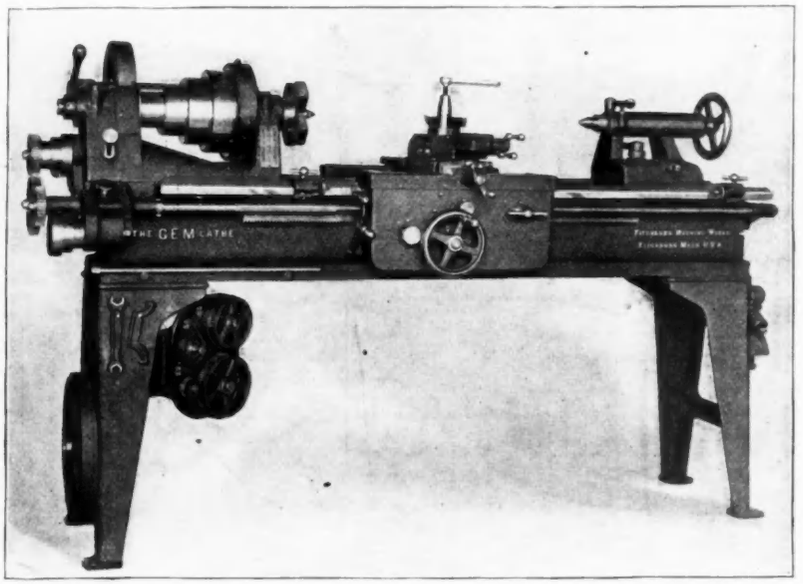
It will be noticed that, in addition to the usual flange on chuck face plates, I have added a hub which projects into the holder, and while backing up the drawing in ring *A d*, it also gives a much greater and firmer holding surface, making it possible to substitute on face plate for another any number of times without injuring the accuracy of the holder, so long as reasonable care is exercised in regard to dirt, etc. It will be found convenient also in making the holder to have the outer end of it formed in the pattern, as shown in Fig. 2. This gives a safe and easy gripping surface for the first operation of chucking, and after fitting the lathe face plate to the chuck and placing upon the lathe spindle, this outer end can be turned to its proper form with the universal slide rest.

▲ ▲ ▲

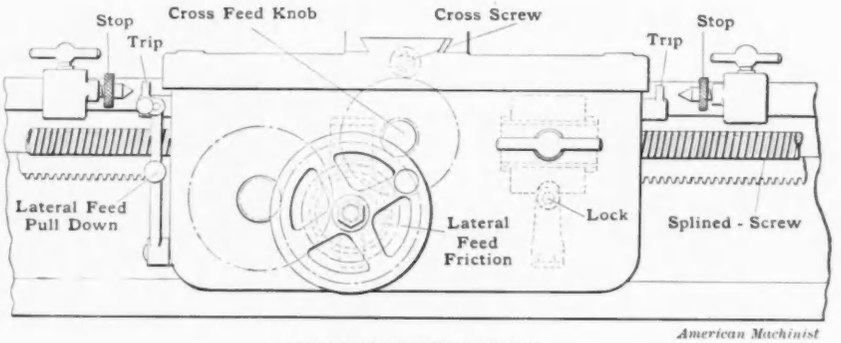
The "Gem" Lathe.

The latest production of the Fitchburg Machine Works, Fitchburg, Mass., the Gem lathe, shown herewith, is a new lathe throughout, from new designs, drawings and patterns, and embraces an unusual number of new, interesting and valuable features. The lathe shown is 14-inch swing with 6-foot bed, the latter being, of course, variable, according to order. The bed has box ties and is made deep and stiff. The legs are a distinct recognition and embodiment of, and a return to, first principles. The head-stock is stiff and heavy, webbed under the cone, and the gears are covered by guards. The tail-stock is so webbed as to allow the cross slide to be operated when swiveled. The tail spindle screw is graduated to thousandths of an inch for gaging depths in drilling. The set-over of the tail-stock is graduated and has a taper scale for sixteenths to the foot. The binder is in the right spot, and clamps quickly and firmly.

The carriage has long bearing on lateral ways, is gibbed the full length at the back, and is quickly clamped for cross-feeding. The compound swivel rest is graduated to 90 degrees each way. The power cross-feed is operated in the apron. The cross compound screw and the thread-cutting stop screw are both graduated to thousandths. The Chapman duplex feed, which we have previously described, is employed. The feed table is simple and novel, having an automatic friction by which the lateral feed can be instantly started or stopped, and automatic and hand stop operating in either direction. The rack pinion is freed by pushing a knob in the apron, saving wear on feed works when screw cutting, but can be left intact as a locking device. Lead screw nut and lateral feed cannot be thrown in at the same time. The lathe, as will be seen in the half-tone, provides a place for everything belonging to it. The swing of the lathe over the carriage is 8¼ inches.



THE "GEM" LATHE.



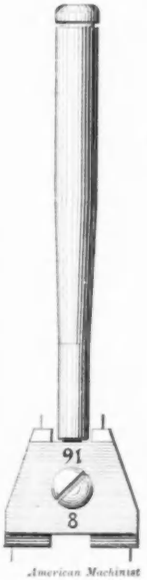
AUTOMATIC FEED STOP.

The cone diameters are 8 1-32 to 3½ inches; driving belt, 2 inches; hole in spindle, 1 1-32 inches; front bearing, 1⅞ x 3¾ inches; back bearing, 1 9-16 x 3½ inches. The lathe cuts threads from 4 to 40, including 11½ for pipes. The spindle speeds are 10 to 482. Fig. 2 shows the automatic stop.

▲ ▲ ▲

Quartering Keyway Cutter for Locomotive Axles.

We illustrate herewith a new machine intended to mill the keyseats for the two ends of locomotive driving axles at the same time and correctly quarter them. It will be seen to consist of a stationary and movable head at each end of the lathe-like bed, the adjustable head being intended to accommodate different lengths of axles and to provide for putting them in and taking them out. Suitable milling cutters will be seen, which are properly quartered in the construction of the machine. A single driving cone at the fixed head drives the machine through spur and worm gearing—a shaft for operating the sliding head being concealed by the axle in the machine. The feed of each head is, however, independent through top slides on the heads, which are gibbed to the saddle and carry the gears and cutter spindles. The spindles will be seen to be hung by swiveled pieces which are fulcrumed at the center of the worm-wheel shafts; thus allowing the cutters to be adjusted for different diameters of axle and depths of keyway. The top carriages feed toward one another, thus milling both keyways at the same time. It will be observed, of course, that not only are the two keyways cut simultaneously, but that the usual operation of reversing the shaft to mill the second end is dispensed with, and at the same time, with accurate construction in the first instance, correct quartering is insured. The machine is the invention of Chas. Carney, engineer of the Brooks Locomotive Works, and is manufactured by the Newton Machine Tool Works, Philadelphia, Pa.



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Fischer's Circle Divider.

We illustrate herewith a new drawing instrument for dividing circles into any number of equal parts with a degree of accuracy sufficient for most purposes. It consists of two German silver plates which clasp between them two spacing points on each side, which are fixed in position with great accuracy.

The instrument is based upon the fact that with fairly large circles short arcs do not differ materially in length from their chords, and the instrument should be used with an understanding of what its limitations are, if satisfactory results are to be obtained. Its method of operation will be understood from Fig. 2, in which the outer arc is to be divided into spaces equal to one forty-eighth part of the circumference. To accomplish this division a second circle is drawn concentric with the first with radius equal to 3 inches, this radius being 48-16 inch. If now the points on the 16 end of the instrument be used as spacing points on the second circle, they will divide it into 48 parts, and the radius lines carry these divisions to the original circle. Of course the second circle may be larger or smaller than the first, depending upon circumstances. Whatever the number of divisions required may be, the radius of the auxiliary circle is made as many sixteenths of an inch as there are divisions required for the entire circle. The second side of the instrument, stamped 8, is used in the same way, except that in this case the radius of the auxiliary circle is made as many eighths of an inch as the number of divisions required. It is claimed that where the number of divisions is greater than 45 and less than 90 the total error is less than one one-hundredth of an inch per quadrant. Of course the error grows rapidly as the auxiliary circle grows smaller, and to avoid this, where a small number of divisions is required, the actual divisions should be a multiple of this number, and then only a portion of the division be used.

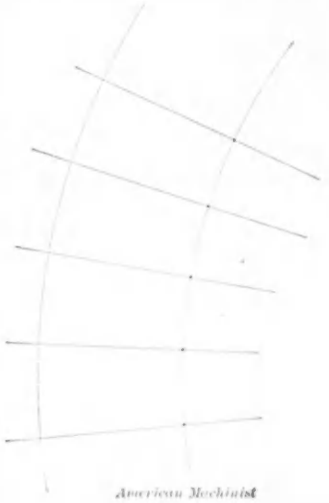
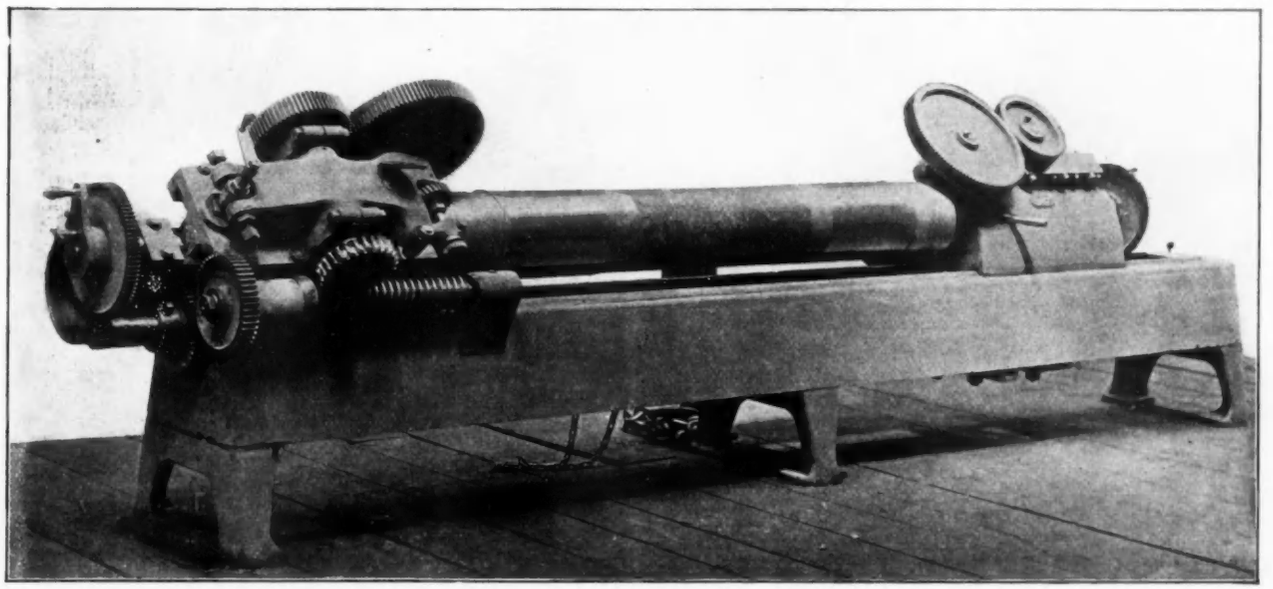


Fig. 2

For example, if the circle is desired to be divided into 15 parts, it should really be divided into 45, when every third point will give the division required.

The instrument can also be used as a



QUARTERING KEYWAY CUTTER.

protractor, since it is obvious that if the cicle be divided into 90 parts the value of each part will be 4 degrees. For this purpose it is best to use a radius of 90-8 or 11¼ inches, when the 8 end will divide the circle into 4 degrees and the 16 end into 2 degrees. For finer divisions a common scale applied to the chord will then give ten minutes for each thirty-second of an inch. In thus laying out large angles, it is advised to begin with the nearest angle given by a triangle, and then lay out the difference only by means of the instrument.

If intelligently used, the instrument should be of a good deal of value in laying out gears, chain wheels and many other pieces of mechanism. It is being placed on the market by Keuffel & Esser, New York, and is supplied with a suitable case to protect the points from injury.

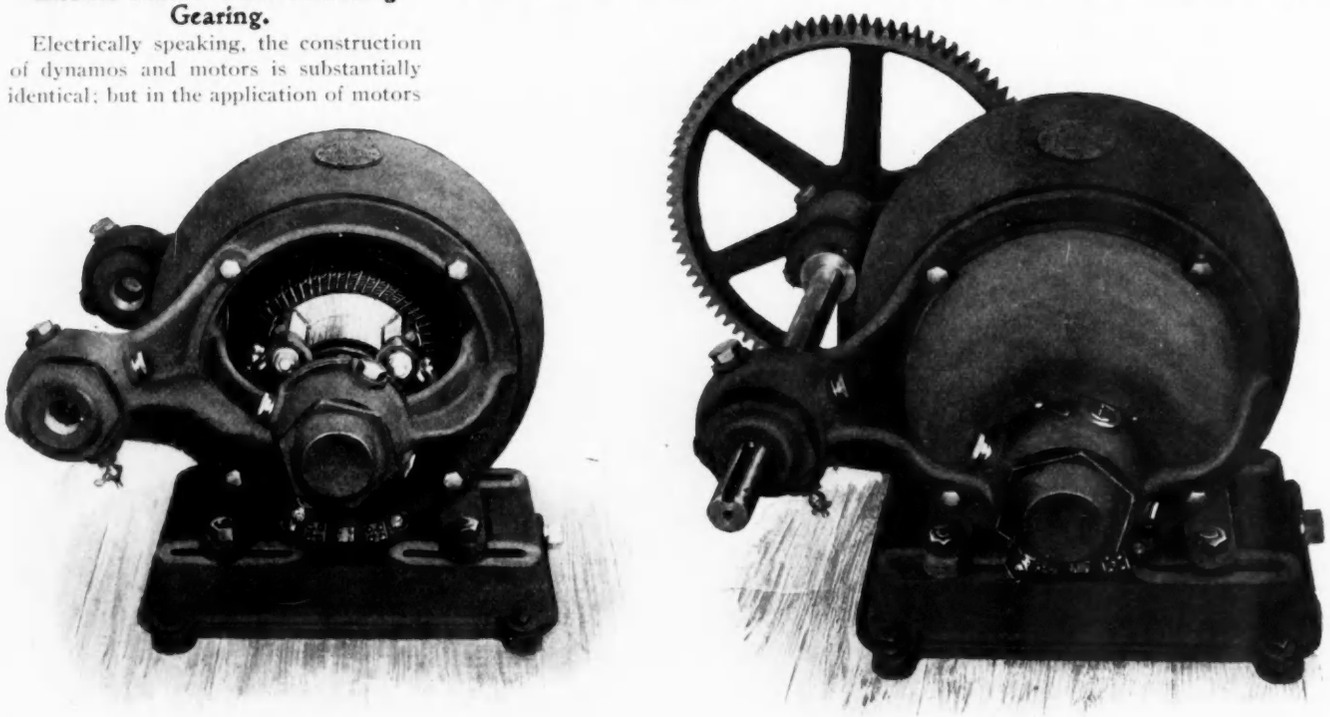
▲ ▲ ▲

Electric Motor with Reducing Gearing.

Electrically speaking, the construction of dynamos and motors is substantially identical; but in the application of motors to various uses, means of adaptation to various conditions and surroundings are found desirable, and we illustrate herewith a motor which has just been placed upon the market by the Northern Electrical Manufacturing Company, of Madison, Wis., in the design of which attention has been given to these points. The necessity for speed reduction in a great many cases is paramount, and it will be seen that this motor is arranged with a supplementary shaft having a reducing gear connected with motor shaft. It is also frequently desirable to suspend the motors in an inverted position from the ceiling overhead in order to avoid building out brackets from walls or posts. The motors here shown may be so placed in an inverted position by simply changing the position of the oil drip cocks on the bearings, and the pins directly opposite which hold the bronze boxes in place. In cases where it is desired to bolt the motor to a post or side wall, that is half invert it, the oil cocks and pins would be moved only half-way around in order to bring the pins at the top and drip cocks at the bottom.

Fig. 1 shows the motor with second shaft and gear out and protecting cover removed, while Fig. 2 shows these parts in place. The covers, it should be remarked, are so made as to shed any water coming from above.

The gear shaft will be seen to be keyseated at its free end, by which it may be belted to an individual machine, or by means of a coupling it may connect directly to a line shaft, the arrangement being flexible in several directions.



ELECTRIC MOTOR WITH REDUCING GEARING.

Armature and Commutator Insulation.

BY WM. BAXTER, JR.

The proper insulation of electrical machinery is not so simple a problem as would appear from a superficial consideration of the subject. The difficulties, however, arise wholly from the fact that the insulating material must be confined within the smallest possible space. The insulation is very successfully accomplished with the wire concerned, the covering of which is from four to five thousandths of an inch thick, for sizes smaller than No. 9; but when it comes to the separation of the wire from the body of the machine, the case is very different. As a rule, the designer reluctantly allows as much space as his best judgment indicates, and frequently, when the machine is finished, it is found that the wire occupies more room than had been allowed for it, and as a result the thickness of the insulation has to be reduced.

In so far as the field coils are concerned, there is seldom any difficulty in this direction, and in fact there should never be any, as space in that part of the machine is not so valuable as in the armature, and there are no mechanical considerations that require the reduction of the insulation to the smallest possible thickness. In the commutator the thickness of the insulation between the segments is governed, more by the width and hardness of the latter, than by the tendency of the current to jump across the space, and is always more than is necessary for the latter purpose, except in cases where the sparking is very great. The insulation between the segments and the supporting hub, however, should be made as thin as possible to secure a strong mechanical structure, since the insulating material is always much weaker than the metal it separates.

In the armature, space is very valuable, from the fact that it is the aim to get the greatest number of turns of wire without increasing any of the dimensions. Owing to the construction of armatures, it often happens that a small difference in the thickness of the insulation will make a decided difference in the capacity of the machine. To illustrate this point, suppose we have an armature upon which we desire to wind, say, fifty coils, and that

we find that by placing between these an insulation of three-hundredths of an inch thick, we can get 175 turns of wire in one layer all the way around the armature, which is at the rate of 3½ turns per coil in each layer. Since we cannot place a fraction of a turn in the coil, we are forced to either reduce the number to 3 and make the insulation much thicker than necessary, or to change the number of coils so as to be equal to the number of turns divided by either 3 or 4. If we place three wires in each layer, we will require 58 sections, and this may reduce their width so much as to render it necessary to enlarge the commutator, which might not be desirable. If we make the number of turns in each layer 4, the commutator segments will be reduced to 44. So great a reduction might be objectionable on account of the increase in sparking that it would produce. We would then find that to increase the number of coils to 58 with 3 turns per layer would not be desirable on account of its reducing the width of the commutator segments too much; that reducing the number of coils to 44 with 4 turns per layer would also be undesirable on account of its increasing the sparking, and as we do not desire to reduce the capacity of the machine or to change the diameter of the armature, we would find ourselves in something of a quandary as to what to do. At this stage we would be very apt to conclude that by reducing the thickness of the insulation slightly, we could increase the number of turns to, say, 188, and thus get, 47 segments in the commutator. Having reached this point, we could easily persuade ourselves that there would be no objection to slightly increasing the diameter of the armature so as to get in one more coil, which would increase the number to 48, and this being so near to our original number (50), would be entirely satisfactory; but in the meantime the insulation will have suffered a reduction from its original thickness.

If there is but one insulating barrier between the wire and the frame of the machine, as shown at *N*, in Fig. 1, and at *A*, Fig. 2, the results following the giving away of this at any point may be very serious. Supposing the frame of the machine is not insulated from the ground, then if there is a leak at any point in the entire network of wires constituting the circuit, a short circuit will be established between this point and the defect in *N* in the armature, and, except in extreme cases, the current that would pass through it would be so great as to cause an extensive burn-out at *N*. If the machine is well insulated from the ground, there is still danger of there being a defective spot in the field coils, through which a short circuit can be completed.

What is true with respect to the armature is also true with respect to the commutator. If the only insulation between the shaft and the segments *C* were that at *M*, the breaking down of this at any point would result in a short circuit, if there were another defect at any part of the circuit. A leak at *N* and one at *M* would result in a short circuit within the armature; just as if there were two leaks in the latter as at *A* and *B* in Fig. 2. Now, suppose that in addition to the insulation *M* in the commutator and *N* in the armature, we have other insulation barriers at *H* and *I*; then if *M* gives away at one point only, no damage will be done, because the current can go no further than *I*. In the same way it can be seen that a single break in *N* in the armature would be harmless, as the current could not pass beyond *H*.

By providing these extra insulations, it would be possible for the machine to run with a leak in the armature, the commutator, and even the field coils, if in the latter case the machine were well insulated from the ground. In order to develop a short circuit in the armature, under such condition, it would be necessary to have two defects in the insulation *N* between the wire and the core, as shown at *A B*, in Fig. 2. These same conditions would have to be fulfilled to obtain a short circuit in the commutator.

There is another advantage in using this double insulation, and that is, that the insulations *N* and *M* can be reduced in thickness. This is owing to the fact that when only one insulation is used, it is liable to be subject to the entire strain due to the full electromotive force of the circuit, and therefore must be sufficiently strong to withstand it. This condition of things will exist whenever the frame is not insulated from the ground, and there is a leak at any point in the whole circuit; and it will also exist even if the frame is insulated, providing there is a leak in the field coils. When the insulations *H* and *I* are used, the rim *B* and clamping ring *D* of the commutator, and the rim *F* of the armature, will be dead, as it is called; that is, they will be out of the circuit, even in the case of a ground connection or a leak in the field coils, as the current could not pass beyond the hubs *I E*. Since the armature ring is itself

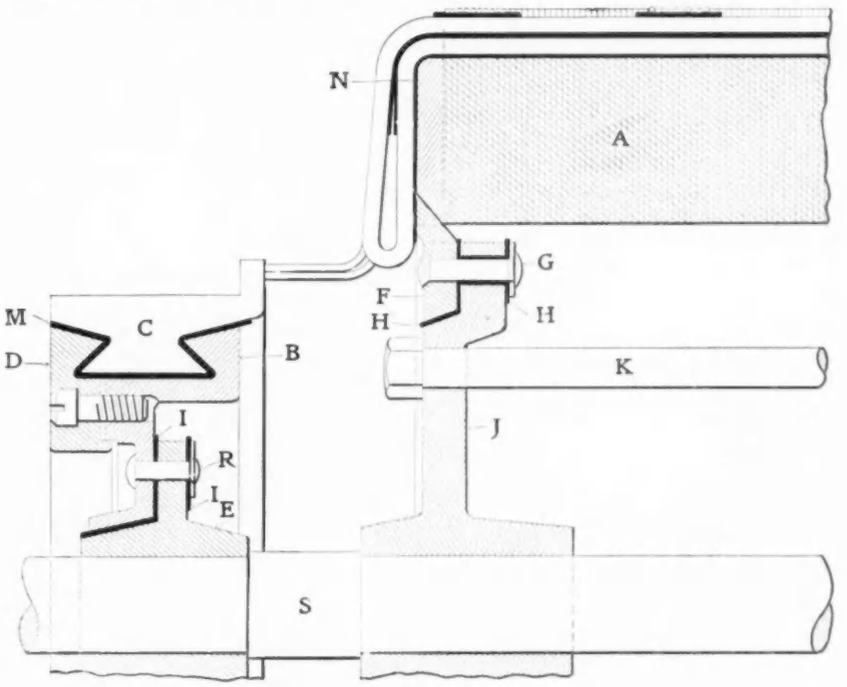


Fig. 1

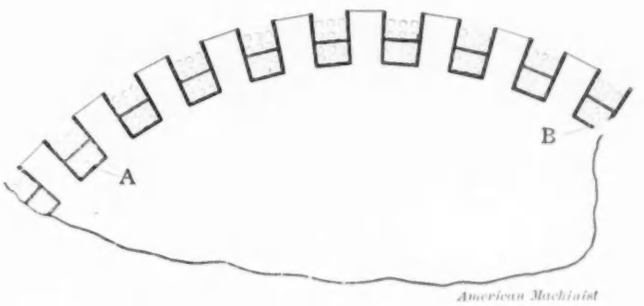


Fig. 2

DOUBLE INSULATION.

insulated, there would be very little tendency for the current to break across a weak point in the insulation *N*, and it would not do so unless there were two such points, as at *A B*, in Fig. 2.

Another advantage of this construction, from the manufacturer's standpoint, is, that it is the cheapest. For commutators of large machines, it is desirable to make the rim *B* of steel, so that when the ring *D* is forced up tightly by the screws, the flange may not break off. If the insulation *I* is used, the hub *E* can be made of cast iron, and although not very much will be saved in cost of material, there will be quite a saving in labor, as cast-iron can be bored and key-seated in much less time than steel. The joint at *I* can be made at small cost, as the castings can be made to go together without finishing.

The cost of construction of a small commutator, with double insulation, might be more than if made solid, as the saving in the labor of boring and key-seating the hub, and the difference in the cost of material, might be less than the cost of making the joint at *I;* but with large commutators such would not be the case. In the construction of the armature, the saving would be more decided. With a six-pole machine, if the rim *F* supports the armature core at four points, it must be made of brass, to prevent magnetic leakage; but if the double insulation is used, the part *J* can be made of cast iron, and only the rim *F* of brass, thus saving a considerable in the cost of material. In such a case the only change required from the construction shown in Fig. 1 would be to extend *F* nearer to the shaft, so as to not have the part *G* so near to the core *A* as to cause a serious leakage of the magnetism. With an eight-pole armature, if *F* supports the core at four points, it can be made of iron or steel without interfering with the magnetic action. Without the insulation *H*, the whole spider would have to be made of steel, so as to insure sufficient strength at the points where the core is held, without making these parts too clumsy. By using the insulation *H*, the part *F*, only, would be made of steel, and *J* would be cast iron.

As the joints *I* and *H* are permanent, never to come apart, the castings can be put together in the rough, and therefore at a slight expense. The insulation may be paper, cloth or asbestos, well saturated with shellac. The joint is to be made before any part of the structure is finished off.

To sum up the advantages of double insulation, it may be said that, as the insulation at *M* and *N* can be made thinner, the commutator can be made stronger, and the danger of "arcing" over from the segments to the ring *D* is reduced. The distance from the armature core to the face of the poles can be reduced, in smooth cored armatures, and the width of the teeth can be made greater in those of the grooved type; the result, in either case, being that a somewhat smaller magnetising force will be required in the field coils. A single break in the insulation of the armature and the commutator would not interfere with the working of the machine. Finally, the cost of construction will, in most cases, be reduced.

▲ ▲ ▲

Letters from Practical Men.

Uniformity in the Area of Test Specimens and the Value of the Micrometer.

Editor American Machinist:

Your criticisms on my article in the issue of June 17th involve several points which would be well discussed. First, you say: "When the test bars are of a uniform cross-section and length, the load carried gives all that is needed for the purpose of comparison, and the reduction to strength per square inch is uncalled for." I cannot agree with you on this point. The foundry is daily passing to greater exactness in its working, so as to better insure certainty in obtaining desired results. Why you should at this stage of progress say that all can accept a test bar that may vary from 1-64 inch to ¼ inch larger in cross-section than some other, made from the same pattern, as indicating two brands or mixtures of metals to be the same, [We have said nothing of the kind.—Ed.] by reason of the two bars breaking at the same load, when all insist that for steel or wrought iron, note should be taken of the least difference that might exist in the area of test specimens, does not strike me as a consistent assertion or practice for anyone to advocate. [We have made no such assertion and have advocated no such practice.—Ed.] There is much that might be said on this point to show wherein there is cause for the engineer and founder to be exacting in taking note of the least difference that might exist in the area of test bars cast off from one pattern, as there is in the machinist laboring to get his test specimens turned or planed down to exact standard measurements. To demonstrate the errors of not taking note of the difference that might exist in the area of test bars, cast from the one pattern, I need only present two tests of 1-inch square test bars, 12 inches long, one of which broke at 3,500 and the other at 3,428 pounds, a difference by the actual breaking load of only 72 pounds. To those believing in reducing to strength per square inch or the use of the micrometer, the difference of what was supposed to be merely 72 pounds, as shown above, is proved to be 269 pounds. Micrometer measurements of the above 1-inch square bars were, respectively, 1.002 inches and 1.044 inches, a difference of .042 or about 4-100 of 1 inch—a fineness that is rarely exceeded, if ever, in the casting of test bars from one pattern, and is more often found to be nearer ⅛ inch larger than only 4-100; yet, for all this, you advocate it as being unnecessary to take micrometer measurement of test bars, [We have done nothing of the kind.—Ed.] not even going so far as to say that common rule measurements would be well taken. In most cases, the man that takes no note of the difference that is bound to exist in the area of test specimens, cast from the one pattern, might as well take no tests at all, [And the man who compares bars of different cross sections by your methods might as well make no tests at all.—Ed.] and would be better guided by the swipe of a sledge hammer in breaking shop "gates" or scrap iron. This is to be said for the man when on the ground of action. For the man off from it, that has to accept records of tests at a distance, such tells him little or nothing. How is such a man to know whether the tests made at a distance from him, which would indicate like strengths, etc., are from bars of like area, or differing sufficiently in size, if closely measured, to show that one iron was greatly superior in strength to another. No, sir, those that will not use the micrometer or reduce to strength per square inch, the area of test specimens in testing, are only following the old doctrine, that any old thing will do for the foundry—something which the "American Machinist" in the past reversed, by encouraging and assisting all its writers to labor for the best that was obtainable, to the end of showing that there was not anything too good for the foundry. The importance of taking note of any difference that may exist in the area of test bars, cast from the one pattern, is also illustrated by the query now advanced by the Western Foundrymen's Association, to be discussed at some near day, which is to the effect of asking if it is practical to turn or plane test bars to a standard size, in order to overcome the irregularity found in casting test specimens and annul the necessity of reducing to strength per square inch, which you claim is uncalled for. Progressive founding means exactness (combined with other advancements) to insure the attainment of desired results and lessen the uncertainties of its working. The day is coming when all will recognize the advisability of reducing to strength per square inch, or the use of the micrometer in the foundry, as well as in the machine shop.

The second point to be taken up is, where you say that the two formulas which I gave are for entirely different purposes, and, hence, is proof that I am beyond my depth. I claim no responsibility for using the two formulas referred to. These were offered by men recognized as standing high in mathematics and engineering work, in answer to the same query of obtaining the strength per square inch of the round and square bars shown in your issue of June 17th. I selected these tests of round and square bars for the reason I knew such were well fitted to draw out the inconsistency and errors that existed in present-day for-

mulas, and knowing these inconsistencies, I selected for my work the formula I did. You first thought this formula ridiculous, through your not clearly understanding the purpose for which I advocated its use. Mr. E. D. Estrada, the able mechanical engineer, and others, say that, for the purpose I use my formula, it is correct, and now you admit the same; [We have done nothing of the kind.—Ed.] so, as far as I am concerned, my present interest in the question of formulas lies in the formula I have adopted, and which I will adhere to until one that is correct for reducing to strength per square inch, bars or beams of any length and cross section, is devised.

THOS. D. WEST.

[We are unable to understand how Mr. West can misquote us as he does. Our reply to his letter said distinctly that the reduction to strength per square inch is uncalled for when the test bars are of uniform cross section and length which Mr. West twists into "Why you should say that all can accept a test bar that may vary from 1-64 inch to ¼ inch." We can only account for Mr. West's reversal of our meaning by supposing him to have read our words with his eyes shut. When the test bars are not of uniform cross section of course the reduction is necessary, but if it is to give results of any value, the correct method must be used, which Mr. West does not do, and this is *the* point and the only point whereon we differ. The attention which Mr. West calls to the necessity for accuracy in measuring test bars is beyond doubt deserved.—Ed.]

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Computing the Strength per Square Inch of Cast Iron.

Editor American Machinist:

I have received the marked copy of the "American Machinist" for June 17th, and thank you very much for your kindness.

It seems to me that your objections to Mr. West's method for determining the relative strength of foundry mixtures are not well founded. Mr. West does not advise the use of his method for any other purpose than to compare the relative strength of foundry mixtures. He proposes to use bars of similar cross section, having equal depths, [Mr. West has said nothing about limiting the method to bars having equal depths. Here is the rub.—Ed.] resting on supports 12 inches apart, and broken under the ordinary conditions, and to give the results in pounds per square inch, obtained by dividing the breaking load in pounds by the cross-sectional area of the bar in square inches. You object to this method, because you say: "When the bars are of different cross section, the reduction to strength per square inch, by the method of Mr. West's book, can only lead to error, as those methods are fundamentally wrong." Let us assume that we have four bars, one 2 x 2 x 14 inches, one 2 x 1½ x 14 inches, one 2 x 1 x 14 inches and one 2 x ½ x 14 inches. The cross-sectional area of each bar is different. If they are broken transversely under the same conditions, and the comparison of their relative strengths, made according to Mr. West's method, where is the fundamental error? Will not their relative strength be as the breaking load, divided by the cross-sectional area?

You say that, "When the test bars are of uniform cross section and length, the load carried gives all that is needed for purpose of comparison, and the reduction to strength per square inch is uncalled for," and that the quotation which Mr. West makes from me indorses your claim and limits the use of West's method to bars of uniform cross section. My remarks do not indorse your claim at all; they refer to bars of similar cross section. I take it that by uniform cross section you mean equal cross section. [By bars of similar cross section we understand those having proportional sides. Mr. Estrada seems to consider all rectangular bars similar. By uniform cross section we mean equal cross section.—Ed.]

If Mr. West's method was limited to bars of equal cross section, there would not be any need of reducing the results to pounds per square inch; but since it is applicable to bars of different cross-sectional area, and it is difficult to obtain square bars, the reduction to pounds per square inch is the only way by which the results can be interpreted. [But a correct method is necessary, which Mr. West's is not.—Ed.]

The formulas given in Mr. West's letter are, as you state, for different purposes. The fact that the results are given in each case in pounds per square inch, no doubt led Mr. West to make the comparison. The equivalent loads for the 1-inch section bars should not be given in pounds per square inch. Right here is a case where the reduction to pounds per square inch is uncalled for. The area of a bar 1 inch in diameter is not 1 square inch, yet the result for the load required to break such a bar is given in pounds per square inch.

It would have been better had the results been given as the breaking load for a bar 1 inch square, 12 inches long, and breaking load for a bar 1 inch diameter and 12 inches long.

E. D. ESTRADA.

Pittsburg, Pa.

[We seem to have misunderstood Mr. Estrada's words, as quoted by Mr. West. It is clear now that he intends to limit Mr. West to bars of uniform depth only, as we judge the 2-inch dimension of the various bars named to be the depth in all cases. The difficulty is that Mr. West does not so limit his method, but calculates the cross section regardless of what the proportions may be. The strength of beams varies, of course, directly as their widths, but as the squares of their depths; and it is in ignoring this fact that Mr. West's error lies. It is obvious enough that, so far as small variations of dimensions are concerned, to which Mr. West devotes his attention elsewhere, they are just as likely to occur in the depth as in the breadth, and that any reduction to strength per square inch necessitated by these variations must be made upon correct principles if the results are to have any value, and this can only be done by recognizing the influence of the depth upon the strength, which Mr. West does not do. We think we have devoted all the space to this subject that its importance justifies.—Ed.]

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Straight Lines and Crooked Inventions.

Editor American Machinist:

I am glad that you had a good word to say for the straight line, in your editorial of July 8th. I don't know that the straight line needed it at all, as it is very well able to take care of itself, and if you don't appreciate it, that's loss for you. But it was peculiarly gratifying to me, because I cant help feeling that it was just like a pat on my own individual back. I happen to be constructed on straight-line principles. A rather strange thing has been happening to me lately, and it may be well for me to tell about it right here. As you very well know, I am rather sensitive about my name, and about having any liberties taken with it in the way of curtailing it, or any transmogrification. Well, a particular and tolerably—sometimes intolerably—familiar friend of mine has lately, when I have met him, been getting into the habit of calling me Tecumseh Straight, instead of Tecumseh Swift. I don't believe that he has done it purposely or knowingly, and I have been considerably puzzled to account for it; but I have tumbled to it at last. He's all right. My name is one of significance, and he has caught on to the idea, which is really more important than the word or the name. The name that he gives me carries about the same meaning as my own original patronymic, and both of them, I suppose, belong to me just as much as either. They are neither of them names for any fellow to feel ashamed of. To-come-so-swift is the way to get there, but to-come-so-straight indicates the road you should travel if you are to arrive on time; so it's all right either way.

Speaking about the love for curves and crooks, in preference to straight lines, among a certain class of would-like-to-be mechanics, carries me back to an experience of long ago. In those days that I am now thinking of I was working along steadily in the shop, generally standing all day before a Putnam lathe, and doing all sorts of work as it came along. There came to the shop all the way from California an old fellow who was possessed with a new invention. He was a spiritualist, and a medium at that, and the

spirits had started him on this new invention, and he seemed to have, or claimed to have, some understanding with the spirits that they would stand by him until the invention was completely developed. He had also succeeded in making some arrangements with several flesh-and-blood spiritualists, who were to furnish the sublunary funds needed for the enterprise. The invention to be developed was a machine for heading or topping grain, whatever the correct term may be. The machine was to be driven into a field of ripe standing wheat, or other grain, and to snip off the heads as it was driven along, leaving the straw standing and getting only the grain. Such a machine, I believe, has since been produced, which does the business with more or less success.

I have actually forgotten the "inventor's" name, but it might have been Rogers. Well, Rogers brought with him nothing but his ideas and a crude model showing how the machine might possibly, but not probably look, and also how it might possibly work. Everything had to be designed right from the beginning; there were drawings, such as they were, to be made, and all the patterns. Everything had to be got up, and I was rung in to have charge of the whole thing. This was before the days when every shop had its drawing room and its draftsman, and when, as we do to-day, everything is drawn, and we have a pretty good idea how it will come together and how it will work, before the making is begun. Certainly there was no regular draftsman for our shop, and all the drawing for this job I had to do, and I did it by working nights on it at home, while I kept the lathe running all day.

I had not a particle of faith in the ultimate success of the thing. I had, in fact, a very clear and positive and unwavering conviction that it never could or would be made to work on the lines proposed, and I freely said so; but I made a great mistake that I did not also positively refuse to have anything to do with the thing except to do my day's work as it came along. The result of my experience on that occasion did much toward forming and establishing the resolution, on which I travel in these days, never to accept any position of responsibility or to be tied up any more closely than compelled to with any undertaking that does not first of all enlist my faith as to its feasibility and ultimate success. Neither money nor respect nor consideration are to be found in association with visionary or impracticable schemes, however seductively they may be presented. With these principles in view, I lately had the pleasure of refusing a position as "consulting engineer"—that's what they wanted to call it—to a very revolutionary mechanical novelty which certainly would accomplish the much-promised feat of turning the world upside down, only that it could not first of all be made to turn itself over. It has not taken me very long to be fully convinced that in this latter case I did the wise thing.

But what has this to do with the straight line? Simply that I found that when I began to turn out the drawings for the details of the revolutionary agricultural invention that I am telling of, I found that straight lines were decidedly at a discount with the inventor. Whatever was in hand, the outline of the frame, the spokes of the wheels, the arrangement and connections of the several shafts, or whatever it was, the straight line—the direct and simple device, the cheapest means of accomplishing any purpose—was always quickly discarded if something crooked or more complicated could be suggested. The latter, of course, was more ingenious and original; and what is an inventor good for, if not for his ingenuity and originality? In this case the spirits were in consultation upon the thing as it went along, and I was constantly assured, at second hand, that they were following my work with approval. It may be that the spirits have not much to do with straight lines and direct methods; but practical and successful men know their value, and I propose hereafter to stick by them.

TECUMSEH SWIFT.

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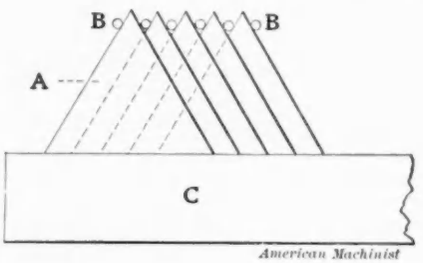
For That Special Mechanical Movement.

Editor American Machinist:

Noticing your problem, "A Special Mechanical Movement Wanted," by H. E. C., in "American Machinist," June 3d, would submit following:

In the sketch, *B* are the points, ⅛ inch apart, which are to be extended along a straight line as far apart as ½ inch. *A*



American Machinist

are triangles overlapping one another, as shown, and free to slide on piece *C*, which piece being caused to advance in direction of arrow (points *B* being suitably guided), the required movement will take place. As will be readily seen, the points can be in actual contact, a result which is impossible with the "lazy tongs" movement.

HANS HUNZIKER.

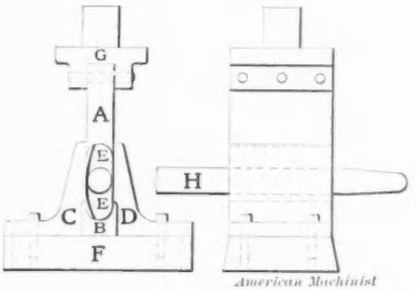
[This arrangement would seem to be unsatisfactory from the fact that it would only increase the spacing of the points, and would not draw them back again if required.—Ed.]

Forming Die for Sheet-Metal Tubing.

Editor American Machinist:

I send you herewith a sketch of a die for forming a tube out of a piece of sheet metal with one stroke of the press. I have never seen this illustrated, and I know it will be new to many.

The punch *A* is tool steel, hardened and drawn to a blue. The die *B* is also steel,



American Machinist

hardened and drawn to a straw. This is to prevent the sharp edges from cutting the surfaces. *C* and *D* are cast iron, likewise *G* and *F*. The arbor *H* is not necessary except in very thin stock; it may be left soft. The sheet to be bent stands at *E*. I have used this die on various thicknesses of sheet metal and I find it a "howling success."

H. H. HARDINGE.

Chicago, Ill.

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Some Steam Engine and Boiler Experience.

Editor American Machinist:

Some years ago I was called upon to examine an engine used for operating tile and brick machinery. The proprietor told me that everything was running along smooth and nice, when suddenly "she begun to work awful hard, and just slowed right down and stopped." All the engineering talent (threshing engine runners) in the country round about was called in, but no solution of the mystery was evolved; so it was decided to go to town and secure the services of an "expert," and I happened to be elected to that dignified position.

The above was about all the information the proprietor could give, and was part of the conversation carried on during a twenty-mile drive across the prairies of central Illinois on that summer evening. In the morning I carefully examined the engine in every detail. It was about a 50 horse-power Ames plain slide valve, throttling governor, overhanging cylinder type. The steam pipe went into the top of the steam chest, and the exhaust pipe went from the opposite side into the ground, when it made a square turn, and was run into drying sheds and supplied steam pipes with exhaust steam for drying the products of the mill. About three feet from the first turn was a tee, and from this a vertical pipe went through the roof. These details I discovered after I had

made an attempt to run the engine. Everything appeared to be in first-class order, and I told the fireman to fire up, and that "she" would go all right. Of course, all of the "talent" was there to see the "expert" fall down on himself, and one member advised me on the quiet that "she was plumb busted, and they would never make her run, till they tuck her to the shop and had her fixed."

Well, I started the machine, and with the results before described; but I noticed that steam came continuously from the cylinder cocks, and after starting the second time, observation showed me that no steam was coming from the exhaust pipe. It was then that the exhaust pipe was investigated, and I found that an angle valve had been ingeniously (?) placed between the tee before mentioned and the steam-chest, for the purpose of regulating the amount of steam that should go into the drying pipes. It seemed to perform that function fairly well. Incidentally, it kept the engine from running away, too, although that was not a part of the original design. Taking the valve-stem and stuffing box out of the valve, revealed the fact that the clapper had become detached from its stem, and the pressure of the exhaust closed the valve. I took it out and replaced the rest of the valve, and then faded away with the rest of the crowd.

Along about this time, a man operating a small elevator stopped at the shop and told the "boss" that he wanted to take a man up with him in the morning to plug a hole in his boiler. He said he had a 20 horse-power fire-box boiler, and that just back of the front head, on the underside, was a hole about the size of a pin, and that a stream of water squirted from it nearly all the time. So I took a couple of gouges, a ½-inch pipe tap and a plug with me. The boiler had been emptied for the occasion, and I was shown where the pin hole was. The very first blow of the hammer sent the gouge clear through up to the octagonal part. It required a patch about 10 by 16 inches to plug that pin hole.

Another time, I examined a similar boiler for an intending purchaser, and a smart blow with a 1-pound hammer let the ball pene clear through, and in both cases the boilers had been doing active duty the day before. The latter was about 42 inches diameter, and was in a sawmill—naturally, perhaps.

But such things do not always occur in elevators and sawmills. Once upon a time, I was making patterns for a man whose name was De Guy, or something else. De Guy was a molder, and he had leased a small shop in one of Minnesota's river towns. Business had not assumed the vast proportions that he was looking forward to, and therefore his force consisted of himself and his man Friday, and myself. A heat was taken off twice a week, and I had charge of the steam apparatus, while De Guy, his man Friday, and a man from the street took off the heat. Very justly, I was not credited with knowing much, and it was with great trepidation and many vigorous instructions that De Guy intrusted me with the duties of fireman for an hour, twice a week. He dwelt on the necessity of keeping plenty of water in the boiler, "'cause that's what makes 'em blow up," he said. The next morning (it was in the winter time, too), after my installation, I was a few minutes late, and when I arrived I found De Guy in the fireroom; the boiler cold and empty. He gave me a withering look, and said, "I told you to keep plenty of water in the boiler, and when I came this morning she was as dry as a bone. It's a wonder you did not melt her." I replied that there was plenty of water in her when I left last night, that I had tried the gage cocks, and that the water glass had shown plenty of water—and not only that, but after I had stumbled through the shop to the front door, I had stumbled back again to assure myself that everything was all right. "Oh, well," he said, "it's no use to talk about it; put in that man-hole plate and turn on the water from the tank and fill her up, and get up steam; they ain't nothing hurt." I replied that I should not put in a drop of water into the boiler until I knew where the water I put into it had gone—and not only that, I should not stay on the premises if he persisted in steaming up till the mystery was explained. He grumbled some, but finally consented. The back end of the boiler was supported by a long mud drum, steamboat fashion. The feed water was injected through this mud drum, and the only blow-off was through the same. On the drum was a cast-iron neck, about a 6-inch opening, and on the boiler was a corresponding neck, and the two were bolted together with six ¾-inch bolts. The neck on the mud drum was cracked entirely off, and the boiler had emptied itself through that crack, as further evidenced by the dampness of the ashes. We jacked the boiler up and put a plate in between the flanges packed with an asbestos gasket. The bolts were corroded until they were about the size of a lead pencil, and were readily twisted off when I tried to unscrew the nuts. Of course, the feed water was put in at another point and another blow-off attached. This boiler had been but a few days before inspected, and had been passed to use with 60 pounds of steam. And yet I don't think that inspection laws nor licensed engineers are what we need. We need some kind of an automatic self-cocking committee of safety, that has a faculty of steering the owners or operators of these steam bomb-shells up against the dangerous section of them at the instant of dissolution, so that they may be dissoluted at the same time. And then may be in the course of time, when it had become an established fact that when a boiler exploded the owner accompanied it, we might possibly be more circumspect about such things.

A. L. BOWEN.

Harvey, Ill.

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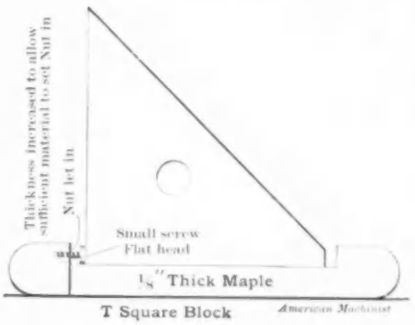
Another Section Liner.

Editor American Machinist:

I inclose herewith sketch showing a section liner, constructed on the same principle as described in "Rapid Methods," in your issue of May 27th; but which is much more substantial. This can be



gotten up cheaply, and I think anyone having much section lining to do will appreciate its value.

The distance between the section lines can be varied by adjusting the screw, making the space greater or less, as the case may require.

GEO. M. NAYLOR.

Peekskill, N. Y.

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The Brown & Sharpe Expanding Reamer.

Editor American Machinist:

In the article on "Tool Room Management," published in your issue of July 8, 1897, as an abstract of a paper read at a meeting of the Mechanical Engineers' Society, of Providence, the term "French expansion type of reamer" was used in connection with remarks in regard to reamers from ¼ inch to 11-16 inch inclusive. This name may connect the reamer with the C. R. C. French expansion tap, when in fact there is no connection whatever, this reamer having been in use by the Brown & Sharpe Manufacturing Company for about forty years. It is a split reamer that expands with a screw having a tapering end.

By making this correction so that your readers may know the kind of reamer referred to, you will oblige

D. D. DONOVAN.

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At Tacoma, Wash., on Sunday, July 11th, a 40-ton fly-wheel of a pair of Corliss compound engines burst, causing $20,000 damage. The wreck of the plant causes the total discontinuance of street-car traffic for several days, if not weeks. As usual, the trouble was with the governor, a rod connected with which broke and allowed the engine to run away.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Publishing Co.,
256 Broadway, New York.

John A. Hill, President and Treasurer.
C. A. Hansmann, Sec'y.

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Mechanics Who Read.

In two or three instances, Mr. Miller, in contrasting the conditions abroad with those here, has mentioned, as an illustration of the difference in the enterprise and ambition of workmen, that those of England and Germany do not read the "American Machinist," or any other publication of a similar character. The reading habit among mechanics is no doubt largely indicative of the ambition of such men to advance themselves, as well as of conditions under which advancement is possible; for it may be safely asserted that where men feel that life is and will continue nothing but a tread-mill, in spite of all efforts to advance themselves, the incentive to reading is absent.

At the same time it seems to us that Mr. Miller's remarks may lead to a state of self-complacency in this matter which may do harm. Of course, the fact that no publication of the nature of our own exists in foreign countries, is strongly indicative of conditions there prevailing; but at the same time it is a pertinent question to ask, how many mechanics in our own country are readers? Our own circulation comprises about 13,000 copies per week, a good proportion of which is among the leading men in mechanical establishments, while another considerable part is among similar men in foreign countries. If these are deducted from the total circulation, and the remainder be compared with the number of men who are earning their living in machine shops in this country, it will not give a ratio which will justify any great amount of optimism regarding the state of ambition existing in the average American mechanic's breast. On the contrary, the facts given by Mr. Miller regarding the painstaking manner in which foreign journals are read by the leading men in German machine shops, especially, lead to comparisons which are the reverse of complimentary to us. London "Engineering" and "The Engineer" have, of course, a considerable circulation here, and their pages are read with more or less care in a good many American establishments; but apart from these, the circulation of foreign journals in this country is very meagre, and we doubt very much if the picture drawn by Mr. Miller would fit in a single American machine shop.

Of course, there is such a thing as too much reading. It is common to hear some physician or lawyer referred to as "splendidly read," but it does not follow by any means that such men are good physicians or good lawyers. The man who reads merely to absorb, rather than to stimulate thought, reads to comparatively little purpose, and this is equally true of reading in mechanical lines as in any other. Men of this sort are those who are forever following the "authorities" and never doing anything that is new. The man who makes some great discovery is, more likely than not, the man who never read in some book that it could not be done. It may be that our German friends err in this way, as Mr. Miller thinks they do in placing undue reliance on technical education, and it may be agreeable to Americans to assume that they strike the golden mean and do just the right amount of reading. We hope this is so, but in our judgment a true interpretation of Mr. Miller's statements is not such as to justify any self-complacency among us on this topic.

The fact that a paper of the character of ours can live here while such a thing appears to be impossible abroad, is, of course, indicative of a real difference; but the comparison made above between the number of those who read it and those who do not, makes it a fair question—does the American mechanic read?

Catalogs in Foreign Languages.

Nothing in Mr. Miller's letter, which appears this week, is of more importance or deserves more emphasis than the remarks which he makes regarding catalogs in foreign languages. The translation of any matter into a foreign language, if the idiom of that language is to be preserved, is a difficult matter; but these difficulties are increased probably ten-fold, when the matter is technical in its character. These difficulties inhere in all translations to foreign languages, but they are probably at their maximum in the German, because of the peculiar character and structure of that language.

The writer was once a witness of the work of translating an American machinery catalog into Spanish. The work was undertaken by a gentleman whose native language was Spanish, and who was a graduate of an American engineering school. His command of the English language was perfect, and when written was in no way distinguishable from that of a native American. The case would seem to have been one of the simplest, but it is a fact, nevertheless, that the translator found himself involved in difficulties of the deepest kind. The fundamental difficulty was that while his native language was Spanish, his technical education had been entirely in English, and his acquaintance with Spanish technical terms was very slight. He had recourse to his Spanish dictionary, and in fact, in the course of the work, bought all the Spanish dictionaries he could find. We all know how unsatisfactory dictionary definitions of technical terms are, and it is only natural that in a language, like Spanish, whose volume of technical literature is small, this condition of things should be still worse, and he soon found his dictionaries of very little use. He studied other so-called Spanish catalogs, and soon developed a state of hilarity which is well described in Mr. Miller's letter as being manifested by German engineers over the "German" catalogs. The preparation of a suitable Spanish vocabulary by this American-educated, Spanish-speaking gentleman occupied months of time before a translation satisfactory to himself could be made.

The above case is only illustrative. It is, however, strictly typical, and it may be set down at once that a translation of a catalog into a foreign language, even by one speaking that language as a native, is practically worthless unless the translator is educated in the technicalities of the subject, and educated in those technicalities in both languages, especially his own.

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Strikes of unusual magnitude are now in progress both in Great Britain and in the United States; the former for the eight-hour day, and the latter for an increase of wages.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(112) X. Y. Z., Canada, asks for a method of removing oil from a belt which has become saturated. A.—The best method we know is to make a liberal application of powdered chalk. If any of our readers know a better method, we should be glad to hear from them.

(113) J. A. T., Canton, Miss., writes: We have an Olds & Son gasoline engine, 7 x 12 inches, running 265 revolutions per minute; please let me know what the explosive power is in an engine of this type. A.—The engine does not run by "explosive" power, but by the expansion of the exploded charge, and the power developed may be ascertained by an indicator, as with a steam engine, or by some form of brake or dynamometer. The Olds engine is of the four-cycle compression type, and if the mean effective pressure for the working stroke was 50 pounds, it would develop 6 or 7 horsepower.

(114) C. G. B., Baltimore, Md., wishes to know how to etch copper dials from a negative or tracing. A.—Make a solution composed of fish glue, 2 ounces; water, 2 ounces; whites of two eggs; bichromate of potash, 80 grains. Let the solution stand for about an hour, and then filter through cotton when it is ready for use. Float the plate twice with the solution and dry it over a small gas stove. After cooling, expose to the sun under the negative for one or two minutes, and then wash under the water tap for about two minutes. Burn it over a gas stove till is becomes a dirty brown color, and then etch with chloride of iron.

(115) L. D. C., Greensburg, Pa., writes: We have air compressed in a reservoir to 80 pounds gage. After this air has been cooled to the temperature of the surrounding atmosphere, say, 80 degrees Fahr., what would be its temperature when permitted to expand down to the atmospheric pressure? We are attempting to cool water for drinking purposes by using air discharged from the cylinders of our molding machines. The air discharges into a 2½-inch pipe about 200 feet long, and we have inserted inside of the 2½-inch pipe two equal lengths of ½-inch pipe opening out into the air, one being connected to the city pressure, and the other to the faucets for drinking purposes. You will understand the expanded air from the molding-machine cylinders, exhausting into the 2½-inch pipe, which surrounds the two lengths of ½-inch pipe, follows this pipe until it is down to atmospheric pressure. Our idea is to ascertain what the temperature should be in the water, and also would like to know as to the advisability of protecting the 2½-inch pipe with non-conducting material. A.—The question is a simple one, and yet it is extremely difficult to answer it satisfactorily, and it certainly cannot be answered with the formal precision which seems to be expected by the writer. With air at 80 pounds gage pressure, and at 80 degrees Fahr., expanding to atmospheric pressure, the theoretical temperature would be 126 degrees below zero, or —126 degrees, and the theory is all right, too. In practice, no such low temperature would be found, because the air, after leaving the working cylinder, would be warmed more or less by friction and by contact with the metallic surfaces of the passages before it could get at a thermometer. The temperature would, however, be considerably below the freezing point, and it is perfectly feasible to use the air for cooling drinking water as proposed, if there is a sufficient volume of air. It will be found that it takes a large volume of air to cool (or to heat) a small volume of water. The 2½-inch pipe should certainly be covered with the best non-conducting material available, especially at and near the machines, from the moment when the expansion occurs. If the water in the small pipe did not flow, it might easily be frozen solid at the point where the air first came in contact with it; while if the water flowed rapidly, it might not be cooled very much. We would be glad to know what results are obtained in this case, as such practical information is rare.

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The Place of Our Destination.—IV.

Without months or even years residence, meandering through the labyrinths of avenues, streets, lanes, passages, alleys, nooks and corners, diving into courts and mewses, boating on the river, going under in one place on foot, in another by carriage, another in an electric car, or still another by rail; dodging about the circles, wandering around the squares and parks, climbing the hills or lounging along the embankment, visiting the museums, theatres, art galleries, gardens, markets, palaces and public buildings, traveling over bridges and over housetops among the chimney pots on the trains, being whirled trough dingy tunnels on the underground roads, viewing from the top of St. Paul's and the various monuments, and living among the people long enough to understand their ways and their language, one cannot comprehend the full meaning of the six letters and two syllables contained in the single word London.

This looks like a long string of words written for effect, and is all right if it has the effect of conveying the fact that London is unlike all other places; not unlike simply because it is larger, but unlike in every way. Aside from the streets of the West End, bounded from end to end by the palatial residences of the rich and the gentry, nearly all the streets, and lanes and alleys are narrow and crooked, and our instinct is to want to cut them out and make them straight and wide—obliterate the inconvenience and rob them of their charm. What a strange people we seem to the people of other countries. Hustle around and save every minute of time, and then spend hours in idleness; grind the lives out of ourselves, screw the last cent out of a bargain, and cut wages to the lowest point, to make a lot of money to give away for some school or college, or something to enable those who are as able to toil as ourselves, to live in idleness. The true Londoner would no more have the streets of London cut out checkerboard fashion than he would think of burying the Thames; it would be no longer London.

There is more convenience in this inconvenient crooked street business, perhaps, than we think; if one wants to get anywhere there is always a short way, and the narrow streets may be a blessing in disguise. They cannot build twenty-five story buildings, not only because the powers that manage things will no more allow one man to rob his neighbor of light than he will of money; but also that in the five and six-story buildings all the business can be done that the streets will accommodate.

If all of lower New York were built up of twenty-five story buildings, half of them would be idle, because people enough could not get to them to make them available. London sixty years ago was practically the same size as the New York of to-day, and years before it had swallowed up one other city and many villages, as New York is to swallow up Brooklyn and the country round about. Thirty years ago New York had a population of practically a million people. Paris two million and London three million. Paris has not gained much over 25 per cent., while both New York and London have nearly doubled, or New York one and three-quarter millions to London five and a half. Taking a circle of six miles radius, in London, and it is no doubt the most thickly populated district in the world. Take a region around Manchester the size of Greater New York, and the Manchester district contains about five millions of people to the Greater New York's three and a quarter.

While it is true that there is very little in London that one can see that he cannot find the like or as good elsewhere, still there is very little elsewhere that he cannot find as good here, and everything is so concentrated that it is easy to see. Enough art galleries to engage one's time to any extent, and the same with the museums. Perhaps a good idea can be formed of the extent of the British Museum when one tries to realize that in the library alone, the rows of books would extend, if in a single line, thirty miles, and I have no doubt the things to be seen and worth seeing would number hard on to a million, if not more. At the South Kensington Museum I took occasion to examine more closely than ever before two pieces of ancient history, one James Watts' first Sun and Planet engine. This peculiar motion, which is one of the things that never needed to have been invented, so attracts one's attention that the cylinder end of the machine is liable to be overlooked. It is a beam engine with vertical cylinder 17 inches by 4 feet stroke, built at Soho in 1788, and ran till 1858, 10 H. P. nominal, 13¾ indicated, with these interesting features: The cylinder has a valve-box at each end, and in each valve-box there are two Corliss valves, one operated from one side and the other from the other, and the valve rocker arms are connected to a rock shaft

corresponding to the Corliss wrist plate, and the rock levers are so set as to produce the Corliss motion, that is, the valves dwell, or remain nearly at rest while under pressure. The rock shaft, however, was not driven by an eccentric, but by tappets on a valve rod worked from the beam, so the valves for a time were entirely at rest.

The origin of the invention of the sun and planet motion shows a curious state of affairs. As the first steam engines were used for pumping, no rotary motion was involved. When a rotary motion was wanted, someone connected the end of the beam to a crank and took out a patent for it. James Watt, to evade the patent, invented his sun and planet motion, without a thought, probably, that the crank was not patentable; it being in common use on foot lathes. Wasted genius in two ways—not as good and not necessary.

The other old machine was the reaper of the Rev. Patrick Bell, built in 1826 and used every year till 1867. As it has often been denied that this was a practical reaping machine, it is worth while to say that there were a number built on the same plan and used; further, that this machine has been worn out in service, and the whole machine anticipates many of the inventions that were patented and fought out in the courts in America, and sustained, which a knowledge of this original machine would have upset. The reciprocating cutter bar with serrated sections is almost identical with present practice. The open guard, over which there was a great fight in the American courts, is embodied in this machine, except that the open part is under instead of over the cutters. It has always been said that no mower or reaper could be run without an open guard, and if that is true this open guard of Patrick Bell anticipated the American patent. Another feature over which there was a good deal of controversy was the tilting finger bar, completely anticipated in the Bell machine, as well as the reel and the traveling apron.

The machine certainly anticipates present practice as well as the Watt engine does our present work. Without detracting anything from the glory McCormick won by promoting the industry, there was nothing comparable to the twine-binder in his work that was not anticipated by the Bell machine. I have been at some pains to study these old machines, to show, in a small way, to what extent our greatest inventions have been anticipated. We are rather prone to say this, that and the other is American, and this or that is the biggest in the world, while the world is a pretty large place, and one may be off in assuming to know what is in it. The Kensington Museum is entirely unlike the British Museum. I do not know what constitutes the dividing line, but among the different departments there is one section devoted to mechanics, historical certainly, as the old machines I have described indicate. Two or three original early locomotives, an old printing press, early sewing machines, cotton machinery, pumps, complete models of the early steamboat engines, and hundreds of the originals of all sorts of machines, many of which serve to show that the old mechanics stole a lot of our modern inventions.

Earls Court, half museum of another sort and half amusement, has, among other things, a Ferris wheel on a somewhat enlarged scale—40 feet larger, I believe, and with forty cars instead of thirty-six. It has lifts (elevators) running up and down two of the incline posts, and a room on each side at the journals of the shaft, which is hollow and large enough for people to walk through from side to side. The whole thing is uglier, about in the same proportion as it is larger, and driven in a different, and it's hard to say whether in a much better or more simple way. Two huge chains go completely around the outside, one at each end, then under sheaves; one on each side being a tightener to take up slack; then the chains pass underground to two portable engines of perhaps 100 horse-power, with reducing gear, coupled together. There is one advantage in this—the noise, which equals that of the Chicago arrangement, is farther away. I guess they guessed at the power required, and as a couple of hundred horse-power seemed to answer, it would seem that they guessed a little nearer than the Ferris people, who had 2,000 horse-power for a smaller machine.

JOHN E. SWEET.

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Steam.

BY DE VOLSON WOOD.

This paper by the late Professor De Volson Wood, which must have been nearly the last of his life work, came to us with the following characteristic note from his hand:

"I intended to say much more about steam, but feared I might be too technical and too lengthy, so I let my thoughts run freely about and closed 'early.'

"DE V. W."

"Johnny, see if the tea kettle boils," said the fond mother to her hopeful, just home from college.

"Why, mother, the tea kettle does not boil, but the water in it does" (in which reply he was more mindful of scientific literalness than of his rhetoric, which authorizes the figure of speech).

Said she, musingly: "How wise these college boys are; larning is a great thing." She, knowing by experience the cost of coal, and wishing to profit by college wisdom, asked how much heat does it take to boil water.

Said he, "A century ago the wisest philosopher could not answer that question, but now it is known that heat can be compared with work, and that if a pound of water could fall 778 feet in a vacuum, and all the energy thus acquired could be transformed into heat, it would raise the temperature of the water one degree Fahrenheit."

She did not understand his explanation, but was greatly impressed with his wisdom. The heat necessary to raise the temperature of one pound of water one degree Fahrenheit, whatever that amount be, is called a British thermal unit with which all other quantities of heat may be compared, and the equivalent value in foot pounds will be 778 times the number of thermal units. The latter, in some simple operations is frequently immense.

For instance, suppose that one pound of water at 51 degrees F., is placed on a stove, or furnace, and subjected to a steady heat, and that in ten minutes the water boils at 212 degrees F. The temperature has been raised 212—51=161 degrees. Suppose, now, that the water continues to boil with constant heat from the furnace and that in 60 minutes one pound has boiled away, passing off as steam. It will be observed that the boiling water has continually the temperature of 212 degrees. According to our supposition it required six times as much heat to vaporize the pound as it did to raise its temperature 161 degrees, or six times 161 thermal units, or 966 thermal units. The experiment of Regnault, whose methods were perfect compared with the crude method here indicated, gave 966 thermal units to the nearest whole number required to vaporize one pound of water under the pressure of one atmosphere. This is equivalent to

$$966 \times 778 = 751{,}548 \text{ foot-pounds.}$$

One appreciates the magnitude of this quantity better by making some comparisons. It is sufficient to raise 1 ton 375 feet or 100 tons 3.75 feet. The energy of ordinary gunpowder is generally assumed to be 250,000 foot-pounds per pound of powder; according to which, it requires more than three times the energy to vaporize 1 pound of water under atmospheric pressure than is developed by the explosion of 1 pound of ordinary gunpowder. The former is done quietly in the course of a few minutes, while the latter is done in a small fraction of a second. This, however, is not all the heat in a pound of water above ordinary temperatures. If the water originally was at 60 degrees Fahr., there were $212 - 60 = 152$ thermal units imparted to the water before it boils; and this must be added to 966, giving 1,118 thermal units, giving nearly 870,000 foot-pounds; and if this heat were imparted in 26½ minutes, or 2.26 pounds so heated every hour, it would equal the energy of 1 horse-power. We need not say that 2.26 pounds of steam, however high the temperature, do not, in practice, produce a horse-power; indeed, it is only very recently that a horse-

power has been produced with so small a weight of steam as 10 pounds per horse-power per hour, and very many engines require from 25 to 40 pounds. One reason for this is, an engine utilizes only a fraction of the heat imparted to it; the very best utilizing scarcely one-fifth of the heat, many good common engines one-tenth, and many one-twentieth, or even less.

Every change of state of aggregation involves a large expenditure of energy. If 1 pound of ice be melted in 10 pounds of water at 60 degrees Fahr., it will reduce the temperature of the water about 14½ degrees, and if this value were correct, it would follow that it requires 14½ × 10 = 145 thermal units to melt a pound of ice. Careful experiments show that it requires 144 British thermal units to melt a pound of ice, and this is equivalent to 144 × 778 = 112,000 foot-pounds of energy. Hence, the energy required to melt or freeze 1 pound of ice is a little less than half the energy in a pound of common powder. When it melts, energy is absorbed by the ice, and when it freezes, energy goes out of the ice into surrounding objects. The energy of melting the pound is equivalent to raising 56 tons weight 1 foot, or of 3.4 horse-power to melt a pound per minute. In view of this, it is not surprising that the effects resulting from freezing and thawing water in the earth and in crevices of rocks produces such marked effects as is frequently observed.

The total amount of heat in any given body is unknown. If a gas were perfect, the amount could be computed; but no known gas is perfect. All the so-called perfect gases have been liquified. Air is a convenient type of a gas. If air be expanded without supplying it with heat, its temperature will fall; and if it were a perfect gas and the expansion infinite, all the energy in it would be changed into work, and the final temperature would be absolute zero, or 461 degrees Fahr. below the zero of Fahrenheit's thermometer. In this way we have computed the total energy in a pound of air at 32 degrees Fahr., the temperature of melting ice, supposing it to be a perfect gas, and found it to be about 64,000 foot-pounds, or about one-fourth the energy in a pound of common powder. A pound of air at that temperature, and under ordinary pressure, occupies nearly 12½ cubic feet; hence, 4 pounds would occupy about 50 cubic feet. Hence, the air in a room 2 x 3 x 8⅓ feet, under ordinary conditions, will contain about as much energy as there is in a pound of common powder. If the speed of a cannon ball be 2,000 feet per second, the kinetic energy of a pound of it will be about 62,000 foot-pounds, or a little less than the total energy in a pound of air under ordinary conditions.

One does not realize the enormous amount of energy stored in bodies about us, as in air, vapors and solids, so long as it is restrained. One may carry powder with impunity if kept from fire, but a spark may make it destructive. Steam boilers are splendid servants, but destructive masters.

The volume of a pound of steam under different pressures is found with considerable difficulty; but at atmospheric pressure, a pound of dry steam is found to occupy just about 26½ cubic feet, the temperature being 212 degrees Fahr. And a pound of dry air at that temperature will occupy just about 16.6 cubic feet, the pressure being the same; hence, under such conditions, air is heavier than the steam, the steam being about five-eighths as dense as the air.

Plans have been made, and are now being executed, for utilizing some 100,000 horse-power of the Falls of Niagara, much of which is to be transmitted to distant points by electrical transmission. It is a grand engineering scheme; but it is put into the shade by the engineering feat displayed in recent Atlantic liners. The former is on and in solid rock, the latter on a floating ship; and the latter carries engines of 30,000 horse-power, together with furnaces, boilers and fuel. If the work of 8 men equaled 1 horse-power, and if there were three shifts in 24 hours, it would require 720,000 men to do the work of the engines on one of these gigantic steamers; and if one steamer could carry the 240,000 necessary for each shift, it would require three vessels to carry the men to do the work on one. This is an illustration of the fact that steam power may accomplish what hand power cannot.

Capt. Ericsson made hot-air engines to drive his steamer the Ericsson, which were very economical of fuel; but the four engines, with cylinders 14 feet in diameter, developed only 300 horse-power; and to develop 30,000 horse-power would require 400 such engines, and would make two rows, each more than 2,800 feet long, or more than half a mile long; while the triple-expansion engines of the Majestic, the boilers, furnaces and fuel are practically hidden in the hold of the ship. Steam is king!

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United States Consul Monoghan, at Chemnitz, Germany, has informed the State Department that a new invention, known as iron felt, has just been brought out in Berlin and Leipzig. It is made from the best woolen materials impregnated with the inventor's patented preparation, which gives it a 2,220 pounds power resistance to every square centimeter. The article is most useful for railroads of all kinds. Placed between the rails and sleepers it deadens sound, prevents shocks, and consequently lessens the wear and tear on the road. The first experiments with the new material were made on the Berlin street railway, over which 360 trains pass daily. The results surpassed the company's most sanguine expectations, and persons living on the line of the road were delighted. Not only was the noise brought down to a minimum, but the wear and tear is materially diminished. This material is to be tried on the new roads that are now being constructed in Leipzig. Old buildings and buildings of iron and stone suffer most from the shocks and noise of passing trains, and where these are, such an isolated material is a necessity. The Consul says that the material seems to be specially adapted for elevated roads.

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We learn from London "Engineering" that: "In some of the American car shops the journals for car axles are now turned up by means of a tool extending the whole length of the journal and accurately ground to the proper shape. The cut is thus several inches wide."

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"Three wise men of Gotham went to sea in a bowl"; three wise men of Sweden went looking for the Pole—in a balloon. In some directions wisdom seems to develop slowly.

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The National Railroad Master Blacksmith's Association will hold its fifth annual convention at the Leland Hotel, in Chicago, commencing on September 7, 1897.

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Commercial Review.

NEW YORK, Saturday Evening, July 17.

THE MACHINE TOOL MARKET.

We have arrived at the season of the year when if there is any disposition in trade to linger and go slow, it will manifest itself with full force; nor is even such a steady department of business as iron-working machinery exempt from mid-summer influences. The general verdict in this line now is, that trade is quieter than at the time of our last monthly report, when indeed there appeared to be some signs of stronger undertone.

Two important contracts for machine tools have been awarded as follows: That for the Watervliet Arsenal to Manning, Maxwell & Moore, and that for the New York Sugar Refining Company to the Niles Tool Works.

Among the other business now on the carpet, attention may be called to the Government proposal, of which we give particulars below. There are also two or three new typewriter companies, notably one in Newark and one in New York City, who have been negotiating for machinery. The suggestion has been made that the reduction in bicycle prices bids fair to create a little demand for bicycle machinery, for the reason that the most modern and economical tools are now necessary to enable the manufacturers to hold their own. Only one party seems to have noticed this phase, however, and he remarked: "We are holding our breaths to see whether it amounts to anything." Another seller speaks of some demand for the improved types of labor-

saving machinery designed for the manufacture of bicycle fittings. For instance, he recently sold one machine to a company who make a peculiar form of handle-bar, to replace two machines which had hitherto been necessary to perform the same operations.

THE TWO SIDES OF THE QUESTION.

An engine company in one of the Eastern States remark casually in correspondence with us, that they are going systematically to work, in a certain way, to prepare for the better times, of which they now see signs ahead.

A machinery introducer who has been going about among the machinery users in Newark, N. J., states that out of fifteen shops visited, one is busy; that one being a concern manufacturing hoisting engines.

Mitts & Merrill, Saginaw, Mich., write us: "Crossly Brothers, Limited, manufacturers of the Otto gas engines, in Manchester, England, have recently ordered one of our large key-seating machines. We are quite busy in this line of work, the orders coming in faster than we can fill them."

THE MATTER OF PRICES.

The head of an important machinery company recently remarked that low prices of steel, so far from being an advantage to the manufacturer of machinery, are a detriment; because the customer who notices a few cents' difference in the raw-material market is sure to expect, on that account, a large concession in the finished products.

A machine tool seller who has been in pursuit of an order in one of the New England States, returned the other day, and remarked: "I come back quite discouraged at the lack of appreciation shown to those who have taken a great deal of trouble to place a high-class line of tools on the market. The question of price controls everything." It is said that one of the principal tool contracts lately placed was taken at a considerable sacrifice in values.

A PENDING GOVERNMENT CONTRACT.

The United States Navy Department has invited bids to supply machinery and machine tools for the Naval Station, Port Royal, S. C. The bids must reach the Bureau of Supplies and Accounts, Washington, D. C., not later than 12 o'clock, August 3, 1897. Most of the tools are to be delivered within forty-five days after date of contract. The following is a brief summary of those required:

A 65 to 70 horse-power Corliss engine; shafting, etc.; plate bending machine; plate straightening machine; two shearing, two punching and one convertible shearing and punching machine; four drills; one boring machine; two planers; four lathes; one vertical boring and turning mill; shaper; bolt cutter; milling machine; screw machine; screw slotting machine; centering machine; two steam hammers; four cranes; three wood-turning lathes, a pattern maker's lathe, and eleven other wood-working machines; forty-four tools for tin and sheet iron work, and a few others.

MACHINERY EXPORTS FOR MAY.

The Monthly Summary of Finance and Commerce of the United States Treasury Department shows a satisfactory value of machinery exported from this country during the month of May. The figures for machinery classifiable under domestic merchandise exported are as follows: For May, 1897, $2,710,706, as compared with $2,089,795 for May, 1896. The amount for April, 1897, happened to be small, perhaps because so much had gone in March, during which month the remarkable figures of $2,936,157 were reached. For the eleven months ending May, 1897, the total is $26,830,490, against $19,757,427 for the eleven months ending May, 1896.

Advance reports of general exports for June, 1897, show that the balance of trade, which for many months past has been notably in our favor, has turned against us, the value of imports exceeding that of exports by $8,563,453, so far as corrected up to time of compilation.

Quotations.

NEW YORK, Monday, July 19.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	10 50 @ 11 25
No. 2 plain, Northern	10 25 @ 11 00
Gray forge, Northern	9 75 @ 10 25
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	— @ 10 50
Foundry forge, or No. 4, South'n	9 50 @ 9 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.10 @ 1.15c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.35 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with extra brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.50c.

Cold Rolled Steel Shafting—Base size, in small lots, from store, 2¼c.

Copper—Carload lots, Lake Superior ingot, 11⅛ @ 11¼c.; electrolytic, 10¾ @ 11c.; casting copper, 10⅛ @ 10⅜c.

Pig Lead—In carload lots, 3.75c., f. o. b., New York.

Pig Tin—For 5 and 10-ton lots, 14.00 @ 14.05c., f. o. b.

Spelter—In carload lots, New York delivery, 4.35 @ 4.40c., f. o. b.

Antimony—The prices still range from 6¾ @ 7½c., according to brand and quantity.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 35 @ 37c.

▲ ▲ ▲

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Gear and milling cutters, adjust. reamers, counterbars and tools, vert. millers, drill pr., cutter and surf. grind., shears. R. M. Clough, New Haven, Ct.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Exp mch. draftsman. Box 100, Am Machinist.

By exp. machinist, toolmaker; comp. and reliable; handled help 11 years; hard work'r. Box 89, Am. Mach.

Draftsman and mech eng., with widest experience, wants resp. position. Box 102, Am. Machinist.

A good planer or lathe hand, used to micrometer msments., 10 yrs. exp., wants pos. 103, Am. Mach.

Foreman pattern maker wants pos.; refs. furnished; salary moderate. Box 105, Amer. Mach.

Wanted—Pos. by exp. draftsman, well up on steam, hydraulic and gen. designing, with shop exp. in modern methods. Box 106, Amer. Machinist.

Experienced supt. wishes change; A1 references from present pos; expd. on engs., mchy., cycles, and tools; cycle factory preferred. 104, Am. Mach.

Toolmaker wants work; 5 years exp. draftsman; 7 toolmaking, in lead. gun, sewing mach., typewriter, bicy. shops; exp. work a spec. Box 94, Am. Mach.

Wanted—Situation by experienced foundry foreman; up-to-date and progressive in modern foundry practice; results assured; no experiment; references. Box 90, American Machinist.

All-around machinist wants position; wish to advance in drawing, tool and jig work; experienced in pearl button manufacturing and designing automatic machinery. Address Box 98, Amer. Mach.

Pos wanted by mech. drafts., with tech. edu. and mach. shop exp.; convers. with marine eng., pump. mach., compr's, hoist. and conveying mach., roads, sewers and surveying. Address Box 96, Am. Mach.

Help Wanted.

Wanted by a technological school a draftsman and a machinist; salaries $600 for forty-six weeks. State experience and give references. Address Box 97, American Machinist.

Wanted—A machine foreman in an Illinois shop, building Duplex Steam Pumps and steam specialties. Do not apply unless you have had recent exp. in Duplex Pump work. Box 93, Amer. Machinist.

Wanted—A few strictly first-class tool makers, familiar with light work. Location, Connecticut, 65 miles from New York. State experience and references. Address Box 95, American Machinist.

Wanted—A man to take the management of an established foundry and machine works employing 25 to 30 men, and to take a small interest in the business. Address Box 101, American Machinist.

Foreman, thoroughly experienced in milling and gear cutting, to take charge of thirty-five milling machines and gear cutters. None but first-class men need apply. Address The Davis & Egan Machine Tool Co., Cincinnati, O.

Wanted, by German tool works of high reputation, foreman for erecting shop; must be competent to introduce American system of building machines in quantities and interchangeable parts. A1 machine hand, for circular grinding in all its branches. A1 lathe hand, competent to take charge of departm'nt; must be able to turn work cheaply and quickly. Those speaking German preferred. Address, stating salary, references, etc., Box 99, Am. Machinist.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Patents, Machinery Designed, Drawings. Henry F. Noyes, 56 Liberty Street, New York.

The Dutton Wet Twist Drill Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

"Modern Steam Engine Construction," parts 1 to 10; 30 cents each. T. F. Scheffler, Erie, Pa.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern, cheap and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

For Rent—A machine shop in connection with our factory; traveling crane and all conveniences; power, heat and light supplied; railroad siding; rent may be paid in work. Address Delaware Hard Fibre Co., Wilmington, Del.

For Sale—Machinery—The following machinery: 7 lathes, 2 upright drill presses, 1 planer, 1 special Monitor, 1 small Monitor, 1 milling and 2 saw machines and others; also shafting, pulleys, belting, tools, etc. Address Cash, care AM. MACHINIST.

Wanted Capital, $10,000—A one-half interest in an established machine tool company is offered a practical man having the executive ability to conduct the business. Strictly modern shop and equipment with ample orders. Address Box 49 AMERICAN MACHINIST.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, AMERICAN MACHINIST.

Wanted—First-class second hand engine, from 400 to 500 H. P., comp. eng. pref; any one having such an engine to offer will please give full particulars as to price and where engine can be seen; parties are also in the market for three or four 150 H. P. horizontal tubular boilers, new or second-hand. Address Manufacturer, care AMERICAN MACHINIST.

An Incorporated Machinery Business—Established 16 years ago, in Philadelphia, Pa., controlling a full line of valuable exclusive machinery agencies, will be sold at private sale for actual value of assets and a reasonable amount for good will. Rating of Co. high. No bills payable out. Reason for selling, prop's time entirely occupied with other business. A rare opportunity for a machy. dealer or mfr. des. an East. branch and an Eastern financial connection in a money centre. Address Box 107, AMER. MACH.

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HARTFORD, CONN.

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WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

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12 to 32 IN. STROKE
MANUFACTURED EXCLUSIVELY.
SMITH & MILLS
CINCINNATI, O.
U. S. A.

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DON'T SPOIL IT
BY GUESSING.
Use the Richards' System of measuring machines; these Gauges are guaranteed to 1/10000 of an inch.
Implements are adjusted at a temperature of 75°.
ASK FOR NEW RED BOOK.
The John H. Rogers, Boat, Gauge & Drill Works,
GLOUCESTER CITY, N. J., U. S. A.
ACCURACY

Always Specify
Morse Tools when your desire is for the best tools for best work

Center Reamer.
Morse makes good tools. Twist Drills, Milling Cutters, Taps, Dies, etc., all of which are shown in the Red Book for Ready Reference.
Morse Twist Drill and Machine Co.
New Bedford, Mass., U. S. A.

PATENT YOUR IDEAS!
The simplest ideas if properly patented will frequently yield large profits.
PHIL. T. DODGE, Patent Attorney.
U. S. and Foreign Patents. Trade-marks, etc.
LOAN AND TRUST BUILDING, WASHINGTON, D. C.

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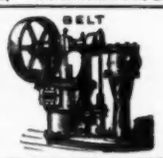
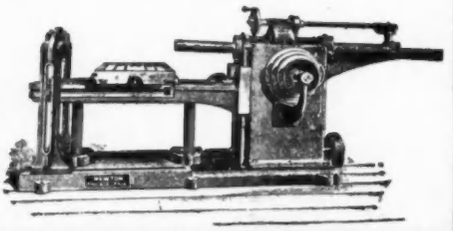
THE CONOVER MFG. CO. 26 CORTLANDT ST. N.Y.



NEWTON
Combined Boring, Drilling and Milling Machines.
NEWTON MACHINE TOOL WORKS
PHILADELPHIA.



Manufactures.

The Bangor (Me.) Gas Company are erecting a new gasometer.

Bentley Bros., Paterson, N. J., contemplate adding to their plant.

At Atkins, Ark., the Atkins Roller Mill Company has been formed.

The Parmenter Company will erect, at East Brookfield, Mass., a machine shop.

An addition is to be erected to the plant of Fogg & Hires, Philadelphia, Pa.

At Mobile, Ala., the Mobile Brewery & Ice Company will erect an ice plant.

The H. A. Thiernan Company, of Louisville, Ky., are erecting a new distillery.

Root & Wiley's mill, at Mount Pleasant, Mich., has been destroyed by fire.

The city of Ozark, Ala., contemplates the installation of an electric-light plant.

At Centreville, Mo., the mill of Emmons & Miller was destroyed by fire recently.

At Brewton, Ala., Messrs. Hill & Maddox will soon begin the erection of a mill.

Avery & Co., whose plant at Saginaw, Mich., was recently burned, will rebuild.

At Philadelphia, Pa., Robert H. Foudner is to have an addition erected to his factory.

At Waxhaw, S. C., the Rodman-Heath Manufacturing Company is to erect a new mill.

The mill owned by H. C. Bowen & Son, at Cheshire, Mass., has been destroyed by fire.

At Curtis Bay, Md., the sugar refinery recently damaged by fire is being reconstructed.

At Nassau, N. Y., Gorgen & Grubb are to have an addition made to their piano factory.

At Philadelphia, Pa., P. C. Tomson is contemplating the erection of a factory building.

The Troy Steam Laundry Company are to erect a new building at Atlanta, Ga., 75 x 200 feet.

At Cicero, Ind., Otto Jaeger, a glass manufacturer of Fostoria, O., will erect a glass factory.

At North Attleboro, Mass., the smelting plant of Messrs. Sherman has been destroyed by fire.

The Lassig Bridge & Iron Works, Chicago, Ill., are to erect a new engine, boiler and rivet house.

The Water Works Board of Bangor, Me., will place new hoisting machinery for head gates.

Clowes, Sothern & Moss, Paterson, N. J., are about to occupy additional space in the Addy mill.

At Phœnix City, Ga., a machine shop is to be erected. Mr. Buchanon has charge of its construction.

At Chicago, Ill., the Weber Wagon Company contemplate the erection of a new boiler and engine house.

At North Birmingham, Ala., the factory belonging to Hardesty & Whaley has been destroyed by fire.

At North Adams, Mass., the Hoosic Valley Street Railway Company will erect a new power-house.

The Horter-Tertion Company, Ltd., has been organized to establish a harness factory at New Orleans, La.

At Williamsport, Pa., the wood-working mill of Messrs. Crouse has been destroyed by fire; loss, about $40,000.

At Twin Bridges, Mont., the Montana Smelting & Refining Company are making alterations to their plant.

At St. Bernard, La., the Poydras Sugar Manufacturing Company is enlarging its plant at a cost of $40,000.

The Blees-McVicker Carriage Company, of

Macon, Mo., contemplate the installation of an engine and boiler.

At Philadelphia, Pa., Thomas Potter, Sons & Co. have commenced the erection of a new factory, 58 x 91 feet.

The J. B. Armstrong Manufacturing Company, of Flint, Mich., has been incorporated. The capital stock is $50,000.

Viles & Robbins' factory at Chicago, Ill., has been destroyed, the refrigerating plant being very much damaged.

The Rock Island Sash & Door Works, at Rock Island, Ill., has been incorporated by A. J. Taylor and Ed. J. Nance.

At Newtown Creek, L. I., a sugar factory is being erected. Mr. Claus Doscher is the head of the firm for whom the building is intended.

The Griffin Wheel Company, of South Tacoma, Wash., is to enlarge its plant. This improvement will include new cupolas, engines, boilers, etc.

The smelter works at Rich Hill, Mo., of which A. B. Cockrill, of Nevado, is manager, and which were damaged by fire recently, are to be rebuilt.

At Newton, Kan., the Santa Fe Railroad are to erect new shops. There are to be three buildings—one 112 x 220 feet, and the other two 50 x 90 feet.

At Little Rock, Ark., the Hailey Mining Company, of Hatton, Ark., has been incorporated. President, W. E. Hailey; vice-president, O. S. Moore.

At Monessen, Pa., the National Tin Plate Company is building a new plant, and it is expected that the plant will give employment to about 1,200 men.

At Pittsburg, Pa., the Keystone Crusher & Roller Company has been chartered. The incorporators are George L. Robinson, W. H. Rea, C. F. Hinman, etc.

The Herrano Manufacturing Company, of Syracuse, Kan., has been incorporated. A. G. Hurst, George O. Hurst and J. R. Irwin are among the incorporators.

At Staffordville, Conn., Mr. Coe, of Worcester, Mass., has purchased a woolen mill which has stood idle for a long time, which he will reconstruct and start up.

The Burlington Elevator Company will erect, at Peoria, Ill., an elevator having a capacity of 200,000 bushels. The most improved machinery will be installed.

Fire in the Rauch & Kenndy foundry and machine shops at Galena, Kan., caused a loss of from $25,000 to $40,000, partly insured. It is understood the plant will be rebuilt.

The Brilliant Silk Company, Paterson, N. J., has leased the old Grant locomotive works, part of which it will occupy with its silk machinery, and the plant will be increased.

At Nashville, Tenn., a charter has been granted to the Union Mining Company, of which W. S. McCall, F. Harris, William Cummings and others are the incorporators.

The Brantford Machine Tool Company, Brantford, Ont., has been incorporated with a capital stock of $150,000, to manufacture machinery, castings, machine supplies, etc.

The Speed Controller Appliance Company, of Taunton, Mass., has been formed. H. H. Shumway, president; M. Westcott, treasurer; the same, with J. P. Corr, directors. Capital, $10,000.

At Chicago, the National Metallurgical Company has been incorporated to engage in the gold and silver refining business. Incorporators: Ed. R. Cocke, Horace S. Hubbard and Ray M. Caldwell.

At Baltimore, Md., the Beardsley Car Brake Company has been incorporated by A. A. Sweeney and Charles H. Beardsley, of New

(Continued on page 39.)

Renshaw's Ratchet Drills, Nos. 1 and 3; *Upright Drilling Machines,* single and multi-spindle, both those in which the spindles are without feed movement and tables are operated by hand or foot lever, and those in which the tables have provision for adjustment, and spindles are fed by hand lever, or by hand wheel, or automatically; also *Horizontal Drilling Machines,* single and multi-spindle. Ask for the Machinists' Catalogue.

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THE PRATT & WHITNEY COMPANY,
HARTFORD, CONN., U.S.A.

New York, 123 Liberty St. Boston, 281 Franklin St. Chicago, 42 South Clinton St
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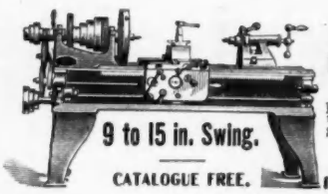
Paris, France, Fenwick Freres & Co., 21 Rue Martel.



CATALOGUE FREE.

4 POINTS!!!! Design! Workmanship! Material! Finish!

All these are comprised in the make-up of our lathes and are the four necessary points in the construction of a good tool. Add to these a FIFTH and a very important one, the price, which we make very low to prompt cash buyers, and you have the story. Our Catalogue will tell you all about our Lathes, Planers, Shapers, etc.

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, CINCINNATI, OHIO, U.S.A.

THIRD EDITION.

KENT'S MECHANICAL ENGINEERS' POCKET BOOK.

1,064 Pages, 12mo, Cloth, $5.00.

"A Great Work Well Done."—R. H. Thurston.

JOHN WILEY & SONS, NEW YORK.

"GREEN RIVER" DRILL CHUCK.

Accurate and strong, holding chucks for nice work, gripping and centering to perfection.

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GREENFIELD, MASS., U. S. A.

Agents in London, SELIG, SONNENTHAL & CO., 85 Queen Victoria Street.

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have done all my patent soliciting work, both for this and foreign countries continuously for the past fourteen years.

Thomas A. Edison

STAR LATHES

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Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12″ Swing.

Send for Catalog B.

Seneca Falls Mfg. Co.
687 Water St., Seneca Falls, N.Y.

Engineers and others

directly or indirectly interested in Power or Steam Heating Plants, should send for our **1897 Catalogue,** mailed free. Contains full description of Jenkins Bros. Valves, Jenkins '96 Packing, Sellers Restarting Injectors and other high-grade Steam Specialties.

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Die and Tool Steel.

NO BETTER MADE.

CRESCENT STEEL CO.
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CHICAGO, ILL.
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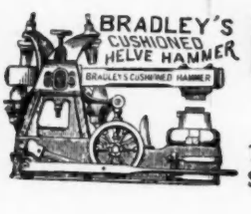
DENVER, COL.



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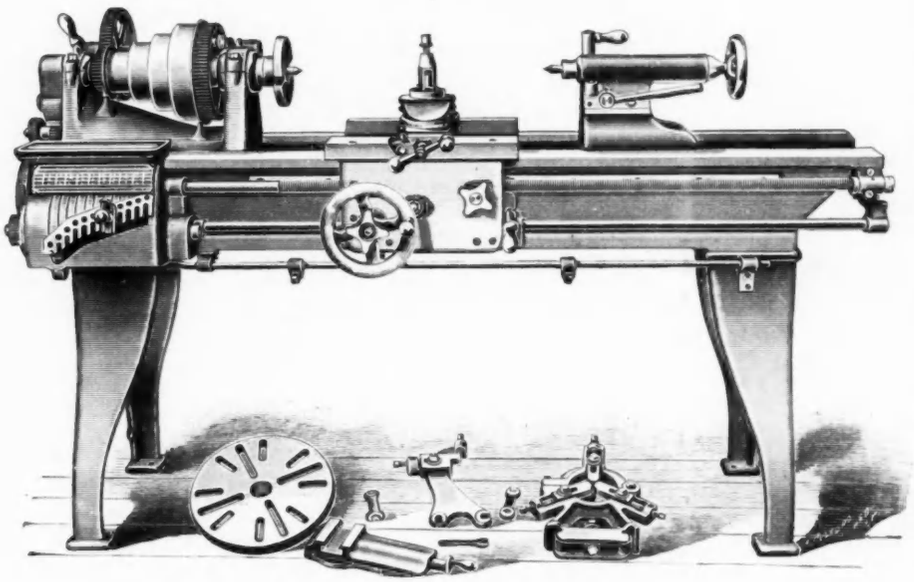
THE BEST POWER HAMMERS ON EARTH.
22 sizes in Helve, Upright and Strap Styles.

Send for Printed Matter.

The Bradley Company
Syracuse, N. Y.

THIS LATHE COMBINES THE LATEST AND BEST IMPROVEMENTS.



14 in. x 6 ft. Hendey-Norton Lathe

With Improved Automatic Stop.

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AUTOMATIC STOP

It is durable, simple, indispensable. It will automatically stop the carriage in either direction. It is equally efficient whether feeding or thread-cutting, running up to a shoulder, boring to bottom of holes, or internal thread-cutting. No danger of spoiling either tool or work. It is a safeguard against accidents in either direction.

CARRIAGE

The carriage reverses in apron; no slamming of countershaft. There is no comparison between this lathe and the old style or common lathe.

THREADS

It has all threads in daily use with simple movement of lever.

FEEDS

Has all feeds in daily use with simple movement of lever. Send for Circular.

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THE HENDEY MACHINE COMPANY,

Torrington, Conn.

Agents for the Pacific Coast, PACIFIC TOOL AND SUPPLY CO., San Francisco, Cal.

European Agents, { **CHAS. CHURCHILL & CO., Ltd., London and Birmingham.**
SCHUCHARDT & SCHÜTTE, Berlin and Vienna.
EUGENE SOLLER, Basel, Switzerland.

(Continued from page 38.)

York; Allen G. Williams, H. C. Bush and Jas. R. Prott, of Baltimore.

Arrangements have been made by which the plant of Luce Carriage & Cutter Co., of Kalamazoo, Mich., will be removed to Elkhart, Ind. It is also expected that the Bellefontaine Iron Bridge Company may move to Elkhart.

A deal has been consummated in Cleveland, O., which involves $1,000,000 and the transfer of one of Cleveland's leading manufacturing plants to a French syndicate. The plant is the Cleveland Machine Screw Company.

At Albany, N. Y., the Albany Boiler Works has been incorporated to manufacture boilers, tanks, plate and sheet-iron work, etc. The directors are Harry L. Van Zile, New York City; Frank Chrysler and E. J. Cantwell, of Albany.

A deal has just been closed by which a new pottery will be erected at East Liverpool, O., by the Sebring Bros. Company. The land has been purchased, and it is estimated that about 200 hands will be employed when the pottery gets into running condition.

Mr. W. C. Callender, of the firm of Callender & Patterson, of Dayton, O., has sold to Mr. Patterson his entire interest in the firm and retired. A stock company has been formed, with Mr. W. B. Patterson as president, which will be known as the Patterson Tool & Supply Company.

Samuel Harris & Co., Chicago, contemplate the erection of a large manufacturing building. It is to be six stories and basement, of steel construction, with pressed brick front, steam heat and elevators, and will cost probably $60,000.

At Newark, N. J., the Rudd Manufacturing Company has been incorporated, the object of which company is to manufacture metal goods. The incorporators are Loyall A. Osborne and Robert D. Beatty, of Pittsburg, Pa., and Fred. E. Osborne, of Newark.

The H. Wetter Manufacturing Company, of Memphis, Tenn., is erecting a new foundry. The officers of the company are as follows: President, A. G. Ryley; vice-president, J. W. Wynne; manager, C. C. Huntington, and secretary and treasurer, J. J. Sohm.

The Rhenish-Westphalian Explosive Company, of Germany, which recently acquired a tract of 600 acres between the villages of Spotswood and Helmetta, in the southern part of Middlesex County, has filed a contract in the County Clerk's office at New Brunswick for the erection of thirteen buildings at New Brunswick, N. J., to cost $20,000.

A group of buildings at Tacony, Pa., for the Castilian Portland Cement Company, is contemplated. The main building will be three, two and one story in hight, 440 feet long by 75 feet deep, and be divided into kiln-room, mill-room, stack-houses and mixing-room. The material used in construction will be of brick, stone, steel and corrugated iron. The engine and boiler-house will be 140 x 50 feet, and include carpenter shop, blacksmith shop, boiler-room, machine shop and dynamo-room. A cooper shop is also to be built, 80 x 40 feet in size.

The New York & Staten Island Electric Company are erecting at Livingston, Staten Island, N. Y., a new power-house of modern construction. The walls of the building are brick, and the roofs have steel trusses covered with corrugated iron. On the building is a large wire tower of steel construction. The engine-room is arranged for a traveling crane of 13 tons capacity. The roof of the engine and dynamo portions of the building is lined underneath the corrugated iron with the Berlin Iron Bridge Company's anti-condensation fireproof roof lining. The Berlin Company have the contract also for furnishing and erecting all the steel framework and covering for the plant.

Brainard Milling Machines and Gear Cutting Machines.

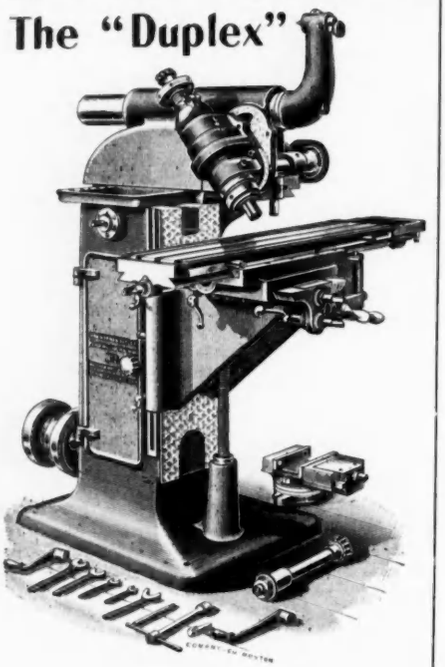
Send for Catalogue.

Brainard Milling Machine Co.

Hyde Park, Mass., U. S. A.

Boston Office: 156 Oliver Street. Chicago Office: 12 So. Canal Street.

The "Duplex"



Saves cutters, saves fixtures, saves time. Vertical, horizontal or any angle of spindle at will.

Best because it does so much.

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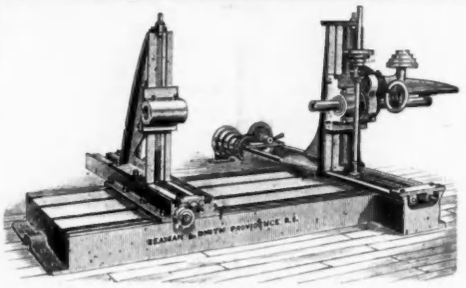
Waltham Watch Tool Co.

Springfield, Mass.

126 Liberty Street, NEW YORK.

WALTER H. FOSTER, Manager.



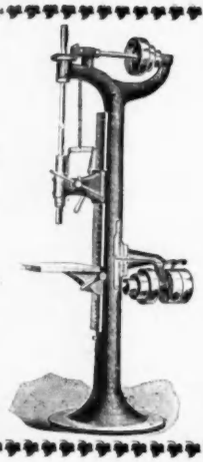
I am very useful and handy but do not recollect making your acquaintance. Should you desire to know me, please ask BEAMAN & SMITH, Providence, R.I., to send you descriptive pamphlet No. 1, that will introduce and tell all about me.

The why of it...

The following extract from a letter written us by Mr. Adolf Bender, General Manager of the De La Vergne Refrigerating Machine Co., is a fair sample of many received from similar sources.

"We are in receipt of your postcard of the 2d inst, calling attention to the marked copy of your paper, which you were kind enough to send us. It was hardly necessary to call our attention to anything contained in the AMERICAN MACHINIST, however, inasmuch as every issue is very carefully read."

Perhaps that tells why good tools well advertised in the AMERICAN MACHINIST pays. The right people read it through very carefully.



"Hamilton" 16-In. Sliding Head Drill.

This is the heaviest and strongest drill of its size—puts a 5-8 hole into cast iron easily. Spindle counterbalanced. Sliding head. Adjustable table. Cut steel rack and pinion. Specially adapted for Bicycle and other light work. Weighs 375 pounds. Price on application. Our specialty, Drills and Lathes.

European Agents:
Chas. Churchill & Co., for Lathes.
Selig, Sonnenthal & Co., for Drills.

Hamilton Machine Tool Company,
20 to 32 Zimmerman Avenue,
Hamilton, Ohio, U. S. A.

ENGINES, GAS AND GASOLINE.

Mietz & Weiss, New York.
New Era Iron Works Dayton, O.
Otto Gas Engine Works, Philadelphia, Pa.
Prouty Co., The, Chicago, Ill.
Springfield Gas Engine Co., Springfield. O.
Watkins Co., F. W. Cincinnati, O.
Weber Gas and Gasoline Engine Co., Kansas City, Mo.
Webster Manufacturing Co., Chicago Ill
Wolverine Motor Works. Grand Rapids, Mich

ENGINES, STEAM.

Ames Iron Works, Oswego, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Holt & Co., S. L., Boston, Mass.
Toomey, Frank, Philadelphia, Pa.

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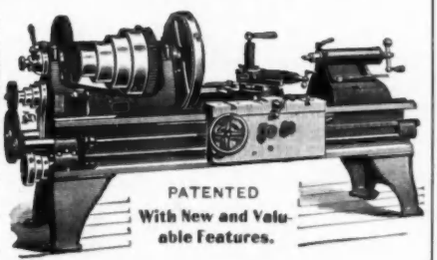

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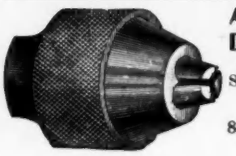

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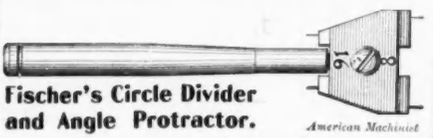

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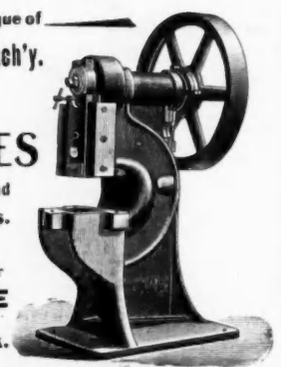

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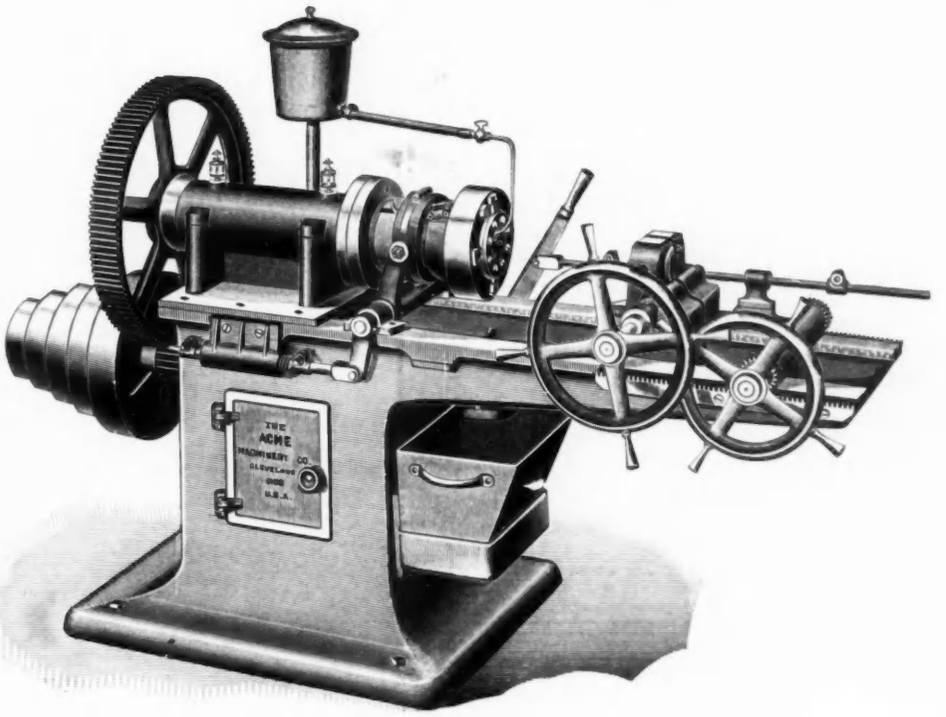

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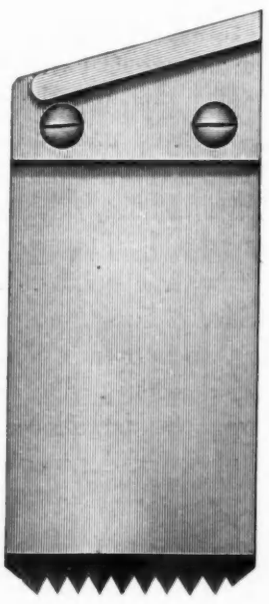

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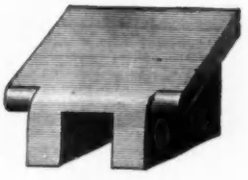

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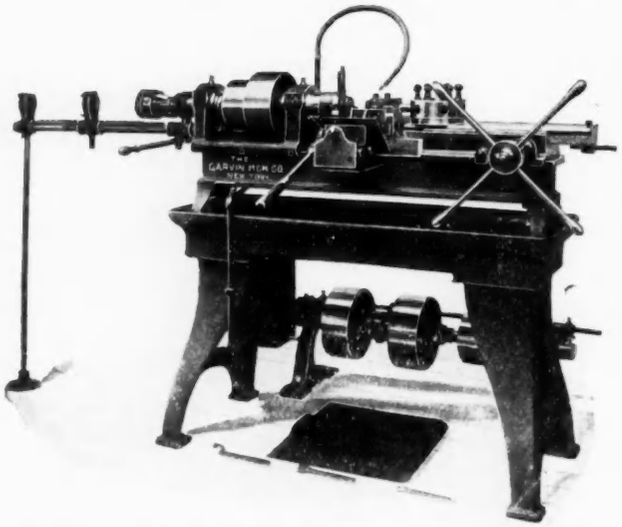

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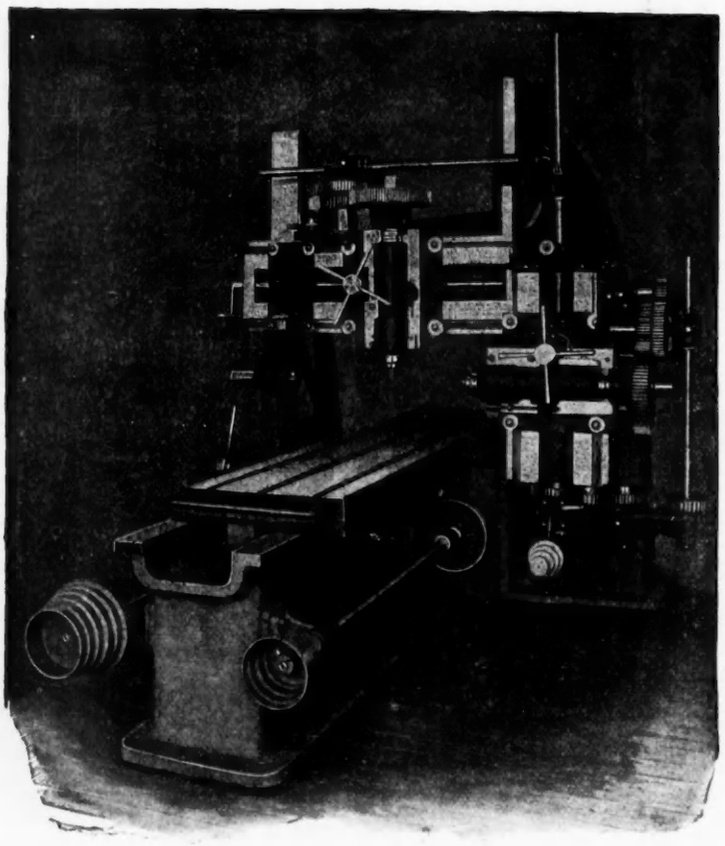

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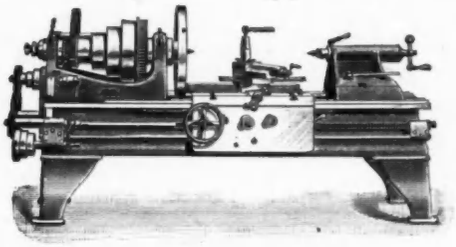

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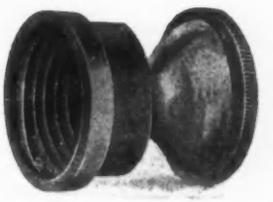

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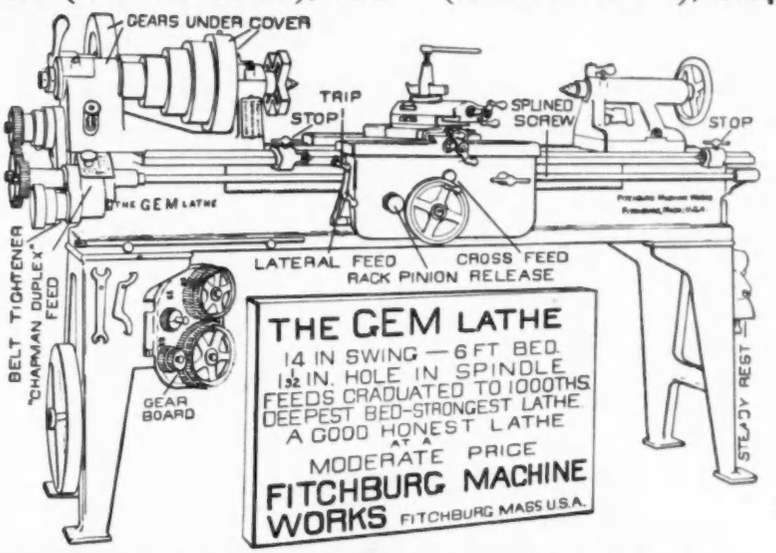

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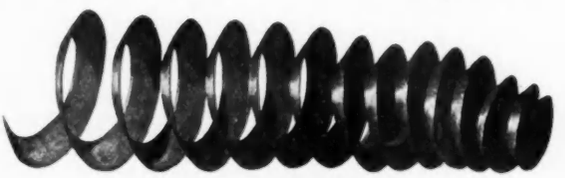

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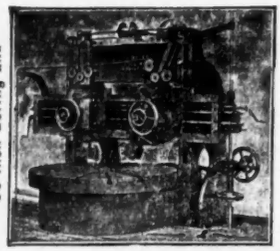

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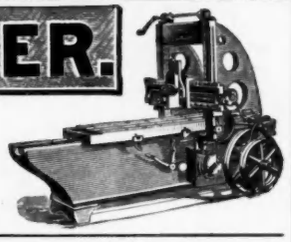

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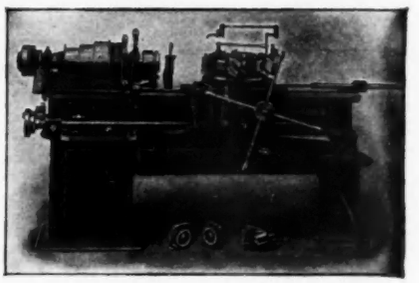

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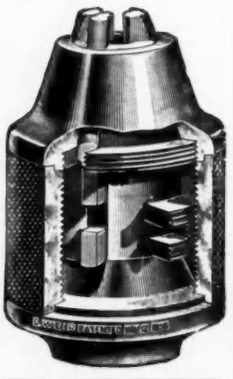

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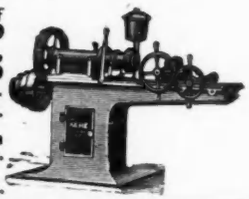

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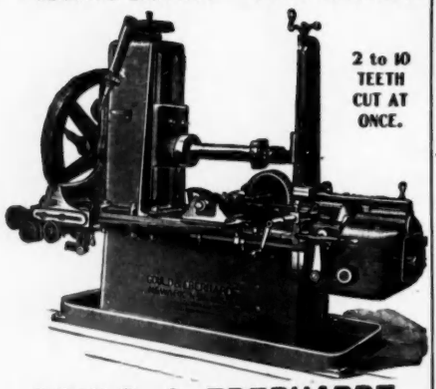

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